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Vol. 13, No. 20
October 31, 1988

Energy Research Abstracts

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October 31, 1988

ENERGY RESEARCH ABSTRACTS

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The Department of Energy's Scientific and Technical Information Program (STIP) is carried out at many levels within the Department and by its contractor organizations. The Office of Scientific and Technical Information (OSTI) in Oak Ridge, Tennessee, provides direction and leadership for STIP and serves as DOE's national center for scientific and technical information management and dissemination. Both DOE-originated information and worldwide literature regarding advances in subjects of interest to DOE researchers are collected, processed, and disseminated through an energy information system maintained by OSTI. The major data bases in this system are available within the United States through commercial on-line systems and to those outside the United States through formal governmental exchange agreements. The current-year records for the major data bases, plus a number of specialized data bases are available to DOE offices and contractors through OSTI's Integrated Technical Information System (ITIS). ITIS also serves as a gateway to other government and commercial systems and provides information merging for customized information products. To manage DOE's information resources effectively, DOE's Scientific and Technical Information Program is one of continual development and evaluation of new information products, systems, and technologies.

ABOUT *ENERGY RESEARCH ABSTRACTS*

Energy Research Abstracts (ERA) provides abstracting and indexing coverage of all scientific and technical reports, journal articles, conference papers and proceedings, books, patents, theses, and monographs originated by the U. S. Department of Energy, its laboratories, energy centers and contractors. *ERA* also covers other energy information prepared *in report form* by federal and state government organizations, foreign governments, and domestic and foreign universities and research organizations. **The user should remain aware that *ERA* coverage of non-report literature is limited to that generated by Department of Energy activity.**

ERA is comprehensive in its subject scope, encompassing the DOE's research, development, demonstration, and technological programs resulting from its broad charter for energy sources, supplies, safety, environmental impacts, and regulation.

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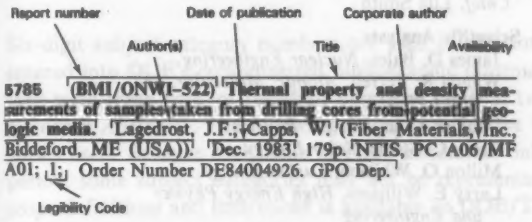
ENERGY RESEARCH ABSTRACTS

HOW TO USE *ENERGY RESEARCH ABSTRACTS*

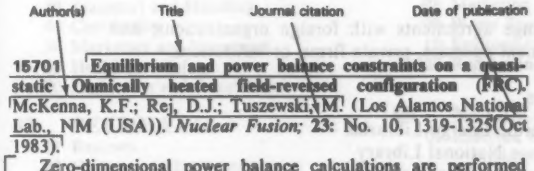
ABSTRACTS IN *ENERGY RESEARCH ABSTRACTS*

The principal elements of abstract entries for a typical research and development report and a typical technical journal article are illustrated below.



5785 (BMI/ONWI-522) Thermal property and density measurements of samples taken from drilling cores from potential geologic media. Lagedrost, J.F.; Capps, W. (Fiber Materials, Inc., Biddeford, ME (USA)). Dec. 1983. 179p. NTIS, PC A06/MF A01; 1; Order Number DE84004926. GPO Dep.

Density, steady-state conductivity, enthalpy, specific heat, heat capacity, thermal diffusivity and linear thermal expansion were measured on 59 materials from core drill samples of several geologic media, including rock salt, basalt, and other associated rocks from 7 potential sites for nuclear waste isolation. The measurements were conducted from or near to room temperature up to 500°C, or to lower temperatures if limited by specimen cracking or fracturing. Ample documentation establishes the reliability of the property measurement methods and the accuracy of the property measurement methods and the accuracy of the results.



15701 Equilibrium and power balance constraints on a quasi-static Ohmically heated field-reversed configuration (FRC). McKenna, K.F.; Rej, D.J.; Tuszewski, M. (Los Alamos National Lab., NM (USA)). *Nuclear Fusion;* 23: No. 10, 1319-1325 (Oct 1983).

Zero-dimensional power balance calculations are performed for a quasi-static, purely Ohmically heated field-reversed configuration. Without compression, the constraint imposed by radial pressure balance limits the power input. Estimates of the energy loss from impurity line radiation as well as from classical and anomalous transport are given. Effects of cold puff gas injection are also investigated.

INDEXES TO *ENERGY RESEARCH ABSTRACTS*

Five indexes are provided for approaching the contents of each issue of *Energy Research Abstracts (ERA).* Each index is preceded by an introduction that details the organization of the index and the principles by which it was compiled. The reader is referred to these introductions for information not found in the index examples that follow.

• Corporate Author Index

Technical report literature is indexed using the name of the organization or institution responsible for the issuance of the report.

5785 (BMI/ONWI-522) Thermal property and density measurements of samples taken from drilling cores from potential geologic media. Lagedrost, J.F.; Capps, W. **(Fiber Materials, Inc., Biddeford, ME (USA)).** Dec. 1983. 179p. NTIS Order Number DE84004926. GPO Dep.

is indexed as:

Fiber Materials, Inc., Biddeford, ME (USA)

• Personal Author Index

Each author's name is indexed in the form appearing on the document abstracted, with the exception that given names are reduced to initials:

Capps, W., *See* Lagedrost, J. F.
Lagedrost, J.F., Thermal property and density measurements of samples taken from drilling cores from potential geologic media, 9:5785 (R;US)
McKenna, K.F., Equilibrium and power balance constraints on a quasi-static Ohmically heated field-reversed configuration (FRC), 9:15701 (J;US)
Rej, D.J., *See* McKenna, K.F.
Tuszewski, M., *See* McKenna, K.F.

• Subject Index

The subject index consisting of entries naming specific materials, objects, and processes is arranged alphabetically. Document titles, informative phrases, or both specific to these entries are arranged alphabetically under the entries.

SALT DEPOSITS
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Thermal property and density measurements of samples taken from drilling cores from potential geologic media, 9:5785 (R;US)
REVERSED-FIELD PINCH
Energy Balance
Equilibrium and power balance constraints on a quasi-static Ohmically heated field-reversed configuration (FRC), 9:15701 (J;AT)

• Contract Number Index

DOE technical report literature is indexed using contract numbers. This index contains the contract number with corresponding abstract and report numbers.

AC06-76RL01830 **Fiber Materials, Inc., Biddeford, ME (USA)** 9:5785 BMI/ONWI-522

• Report Number Index

Technical report literature is also indexed using report numbers. This index includes information on where individual reports may be obtained. Patents and conference papers are indexed here as a matter of convenience. When a report is supplied under an Order Number, that number is included in the availability statement. An Order number–report number correlation is included for convenience.

BMI/ONWI-522 9:5785 NTIS, PC A09/MF A01. Order Number DE84004926, Distribution Category MN-70

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CEA Centre d'Etudes de Saclay
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IEA Biomass Conversion Service
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IEA Coal Research
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Bethesda, MD

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Communication concerning the editorial policy and content of *Energy Research Abstracts* should be addressed to the Editor, *Energy Research Abstracts,* Office of Scientific and Technical Information, P. O. Box 62, Oak Ridge, TN 37831.

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Six-digit subject category numbers are used in the storage, retrieval, and manipulation of bibliographic information entered into DOE's computerized bibliographic information system. The six-digit category numbers are utilized as if they were three pairs of two-digit numbers, the first two pairs being used to arrange the abstract content of *Energy Research Abstracts*. The following listing includes the totality of the 40 first-level and 289 second-level subject categories used. Because each issue of *ERA* announces only those documents becoming available during a semimonthly period, some subject categories may not be represented in every issue. The complete subject category scheme with scope definitions and limitations is available as DOE/TIC-4584-R6 from NTIS for $9.50.

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ENERGY RESEARCH ABSTRACTS

01 COAL AND COAL PRODUCTS

0103 Preparation

REFER ALSO TO CITATION(S) 46248

46220 (DOE/PC/81210—T19) Development and demonstration of a static tube flotation system for producing superclean coal: 11th quarterly technical progress report, ending June 30, 1988. Yang, D.C. (USDOE Pittsburgh Energy Technology Center, PA). 13 Jul 1988. Contract AC22-85PC81210. 19p. NTIS, PC A03/MF A01; 1; GPO Dep. Order Number DE88013065/JAW.

The primary objective to produce a superclean coal (i.e., 0.4–1.0% ash) has been achieved with one of the two selected coals both in the laboratory and the process development unit (PDU) rated at 500 lb/hr. At this scale, a clean coal of about 2% ash with over 95% weight recovery was obtained in a single stage from a 4.3% ash Lower Kittanning coal ground to 150 mesh. By regrinding the first stage concentrate to 500 {number←sign} mesh and feeding the 500 mesh coal to the second stage column, 0.9 to 1.2% ash clean coal was achieved with 60 to 89% weight recovery. While on Pittsburgh seam coal at a similar recovery level, only about 3 to 4% ash clean coal was produced in one stage and a 2 to 3% ash product was reached in two stages of tube flotation with regrind between the stages. Besides the slight difference in achievable grade, most likely due to insufficient liberation of mineral matter, the observed operations and results of the PDU tests were very similar to those of the laboratory tests previously conducted. This indicates that the static tube flotation system can be scaled up almost linearly on the basis of volume. The economic analysis based on the technical data and preliminary cost projects indicates that the static tube flotation system could provide a more attractive product than conventional systems (less cost of a clean coal product at lower ash and sulfur levels). This result is strongly affected by assumptions and estimates made about coal recovery rate, new coal cost, total capital costs, and the required rate of return. 2 figs., 11 tabs.

46221 (DOE/PC/88861—T2) High-sulfur coal research at the SIUC [Southern Illinois University at Carbondale] Coal Technology Laboratory: Quarterly progress report, April 1–June 30, 1988. (Southern Illinois Univ., Carbondale (USA). Coal Extraction and Utilization Research Center). Jul 1988. Contract FC22-88PC88861. 131p. NTIS, PC A07. Order Number DE88014504/JAW.

Research on high-sulfur coal which is taking place at the Coal Technology Laboratory at Southern Illinois University at Carbondale is divided into four general categories: coal science, coal preparation, coal conversion, and coal utilization. The following projects are described: Interactions of sulfur-containing compounds with transition metal clusters and metal surfaces; Reactivity of whole coals, selected pure maceral fractions, and cleaned coal products; Mechanistic study of chlorine removal from coal by high temperature leaching; Coal flotation and flocculation in the presence of humic acids; Microbial removal of organic sulfur; Coal-water interactions; Electro-osmotically enhanced dewatering/deliquoring of fine coal. Individual projects are processed separately for the data bases.

46222 (DOE/PC/90507—T7) Surface properties of coal and their role in coal beneficiation: Technical progress report, [March 15, 1988–June 14, 1988]. Fuerstenau, D.W. (California Univ., Berkeley (USA). Dept. of Materials Science and Mineral Engineering). Jul 1988. Contract FG22-86PC90507. 20p. NTIS, PC A03/MF A01; 1; GPO Dep. Order Number DE88013066/JAW.

The main goal of this research is to delineate the wetting behavior of coal and its subsequent effects on fine coal processing. As both bulk and surface properties of coal are interrelated and have a controlling role on the performance of these processes, a detailed study has been undertaken to correlate their influence on both wetting behavior and the response of coal to flotation and other unit operations encountered in fine coal processing. During the past quarter, the effect of oxidation on dewatering of fine coal was studied. The water content of filter cake of as-received and oxidized Cambria No. 78 and New Zealand coals was correlated with their mean critical wetting surface tension, total oxygen content, and oxygen functional group concentration. 10 refs., 10 figs., 1 tab.

46223 Clean-coal technologies. Hearing before the Subcommittee on Energy and Power of the Committee on Energy and Commerce, House of Representatives, One Hundredth Congress, First Session, May 21, 1987. Washington, DC; Government Printing Office (1988). 168p.

This hearing explored issues raised by the President's dramatic proposal to spend $2.5 billion in federal funds to develop clean-coal technologies. How and where these federal funds would be used was of interest to the committee, since previously the administration saw little role for the government in demonstration projects. Noting that the Presidents proposal links clean coal technology with the problem of acid rain, the chairman points out that the committee has long felt this link appropriate - but wonders if the President anticipates that this massive spending of federal and private funds will substitute for future regulatory requirements relating to acid rain. Ten witnesses include officials of the Department of Energy, Maryland PSC, Ohio State Coal Office, National Resources Defense Council, Reily-Stoker Corp., Northern States Power Co., and American Electric Power Service Corp. In addition, considerable material was submitted for the record.

0104 Processing

REFER ALSO TO CITATION(S) 46221, 46223, 46843, 46843

46224 (CONF-850982—, pp 391-404) Amoco's integrated close-coupled coal liquefaction bench-scale test. Tait, A.M.; Pacheco, M.A.; Schwartz, M.M. (Amoco Oil Co., Naperville, IL (USA)). 1985. NTIS, PC A99/MF A01. Order Number DE88007794/JAW.

From 2. annual Pittsburgh coal conference; Pittsburgh, PA, USA (16 Sep 1985).

For the past decade, Amoco Oil, as an energy related company, has explored all aspects of synthetic fuels utilization. In the area of coal liquefaction, emphasis has been directed towards developing the most effective means of producing coal liquids that could eventually be used to replace petroleum derived liquids. The research has been directed towards both process and catalyst development and has been sponsored in part through contract work with the Electric Power Research Institute and with the Dept. of Energy. These associations have led to our involvement in the H-Coal pilot plant in Catlettsburg and currently with the Wilsonville pilot plant. In addition, the work has resulted in state-of-the-art catalysts, namely the AMOCAT series. Our current contract with the Dept. of Energy is nearing completion. One objective was to

demonstrate a thermal/catalytic two-stage coal liquefaction process in an integrated mode. Since Amoco's developmental pilot plant does not have recycle capabilities, the demonstration was achieved, in cooperation with Hydrocarbon Research Incorporated, by utilizing their integrated bench-scale pilot plant. This paper discusses the results of these pilot studies.

46225 (CONF-880725—3) Mild gasification: Product characterization. Graves, R.L.; Daw, C.S. (Oak Ridge National Lab., TN (USA)). 1988. Contract AC05-84OR21400. 7p. NTIS, PC A02/MF A01; 1; GPO Dep. Order Number DE88015285/JAW.

From Oil shale, tar sands and mild gasification; Morgantown, WV, USA (19 Jul 1988).

From previous studies it is known that light oil can be produced through mild devolatilization or mild gasification of coal and that these liquids have potential as diesel fuels or diesel fuel diluents. However, the yield and quality of these liquids vary with processing conditions. In general, higher yields at higher temperatures result in lower quality products. Some liquids upgrading (or blending) may be required even under mild-gasification conditions: the severity and cost of the treatment will vary with the raw liquid quality. A similar situation exists for the char product in that severe devolatilization tends to reduce the char's suitability as a boiler fuel (but may be satisfactory for other uses). These tradeoffs between product quality, yields, and upgrading requirements determine the overall viability of the mild gasification approach. Samples of mild gasification products will be acquired from existing pilot plant operations. The liquids will be characterized in a laboratory using consistent test procedures. The analyses will include elemental analysis, viscosity, gravity, heating value, aromatic/aliphatic content, and others as appropriate. Determinations of the blending characteristics are to be achieved as well as product stability in the latter stages of the program. The data will be compared to those for liquids from other coal liquefaction processes such as the Exxon Donor Solvent (EDS) process and the current pilot plant operations at Wilsonville. 3 refs.

46226 (DOE/MC/23057—2606) Novel concept development of an internal recirculation catalyst for mild gasification: Progress report, June 1-August 31, 1987. Solka, B.H.; Hill, A.H.; Feldkirchner, H.L.; Babu, S.P. (USDOE Morgantown Energy Technology Center, WV). Oct 1987. Contract AC21-86MC23057. 41p. NTIS, PC A03/MF A01; 1; GPO Dep. Order Number DE88014718/JAW.

Results of 14 separate tests to investigate (1) the lack of CsOH volatility seen in the pyrolysis-gas chromatography tests using CsOH-catalyzed coals conducted during the previous quarter, and (2) the effect of H_2S in the carrier gas on products of mild gasification/devolatilization of Illinois No. 6 coal, are discussed herein. Three tests were conducted in a thermal gravimetric analyzer (TGA) to: (1) determine the volatility of pure cesium hydroxide in steam as a function of temperature and, (2) the effect of coal char on the volatility of CsOH under mild gasification conditions. The results of the cesium volatilization tests show that, as expected, pure cesium hydroxide volatilizes rapidly in steam at temperatures used in mild gasification. The addition of CsOH to coal char and activated carbon enhances their reactivity in steam at mild gasification temperatures while its addition to coal results in the production of more gas and less oils and tar than uncatalyzed coal under the same conditions. However, the results of these tests also indicate that CsOH and rendering it unsuitable as an internal recirculation catalyst. Three tests were also conducted this quarter PY-GC-FID to determine the effect of H_2S in the carrier gas on the products of mild gasification/devolatilization of Illinois No. 6 coal. The results of the coal pyrolysis tests with H_2S and He show no significant difference in the C_6-C_{44} liquid production and distribution, and only a small (5 weight percent) increase in the overall coal conversion using H_2S. 2 refs., 11 figs., 12 tabs.

46227 (DOE/MC/23057—2607) Novel concept development of an internal recirculation catalyst for mild gasification: Progress report, September 1-November 30, 1987. Solka, B.H.; Feldkirchner, H.L.; Babu, S.P. (USDOE Morgantown Energy Technology Center, WV). Feb 1988. Contract AC21-86MC23057. 17p. NTIS, PC A03/MF A01; 1; GPO Dep. Order Number DE88014717/JAW.

Although pure cesium hydroxide volatilizes rapidly in steam at temperatures suitable for mild gasification it also interacts with coal mineral matter under these conditions. This results in a lowering of the cesium hydroxide volatility to the point of its being rendered unsuitable for use as a recirculating catalyst. Alternative inorganic compounds were considered and a number were selected as worthy of further investigation. DOE's guidance was sought and zinc chloride was selected for testing under a no-cost time extension of this contract. Zinc chloride has a vapor pressure that varies from less than 0.053 to greater than 1.0 atmosphere in the 1000{degree}F to 1300{degree}F temperature range. This meets the volatility requirements for internal recirculation under mild gasification conditions. Seventeen pyrolysis-gas chromatography tests were conducted in helium. Four tests used Illinois No.6 coal to provide a baseline comparison with earlier work and the rest used North Dakota lignite. Cesium hydroxide catalyzed lignite was tested to complete observations of the CsOH behavior with coals of three different ranks. Zinc chloride catalyzed lignite was tested to study any effects that it may have on the mild gasification/devolatilization products. The results from CsOH-North Dakota lignite tests were similar to those previously observed with other coals. The effect of $ZnCl_2$ on North Dakota lignite devolatilization include an increase in overall conversion as reflected by a 10 weight percent decrease (relative) in char residue, an increased production of water and carbon dioxide, decreased production of hydrogen sulfide, and a shift in boiling point distribution of recovered condensable organics in the C_6 to C_{44} boiling point range. 3 refs., 1 fig., 4 tabs.

46228 (DOE/MC/23288—2619) Steam conditioning of coal for synfuels production: Fourth quarterly report, October 1 to December 31, 1987. Graff, R.A.; Zhou, P.; Brandes, S.D. (City Coll., New York (USA)). 1987. Contract AC21-87MC23288. 23p. NTIS, PC A03/MF A01; 1; GPO Dep. Order Number DE88015350/JAW.

Conditioning of coal in steam is being explored for the purpose of improving the yield and quality of condensable product obtainable in the mild gasification of coal. Extraction tests were conducted on Mississippi lignite conditioned in steam and helium at pressures of one and fifty atmospheres and temperatures from 572 to 752{degree}F (300 to 400{degree}C). At certain temperatures in this range, a very pronounced increase in extraction yield is obtained from conditioning in steam as opposed to helium. This demonstrates that steam has some effect other than a purely thermal one. Semicontinuous pyrolysis runs with Illinois No. 6 coal were conducted in 50 atm of steam. A marginal improvement in liquid yield is obtained from steam conditioning. It is surmised that the reacting coal is effectively shielded by feed helium in high pressure operation. Tests with Mississippi lignite at atmospheric pressure showed that the conditioning volatiles (obtained in high yield) are primarily gaseous and principally carbon oxides. This suggests a process concept for Mississippi lignite consisting of a conditioning step followed by mild steam gasification. The conditioning step will serve two purposes: first, it will preferentially liberate carbon oxides so that less of these will be mixed with the hydrocarbon gases liberated in the gasification step making separation easier and/or improving the quality of the gaseous product. Second (based on the extraction studies), it will improve the yield of condensables obtained in mild gasification. 5 figs., 2 tabs.

46229 (DOE/METC—88/6095) Proceedings of the thirteenth annual underground coal gasification symposium. Martin, J.W.; Barone, S.P. (eds.). (USDOE Morgantown Energy Technology Center, WV; Gas Research Inst., Chicago, IL (USA)). Aug 1987. 435p. (CONF-8708106—). NTIS, PC A19/MF A01; 1; GPO Dep. Order Number DE88010255/JAW.

From 13. annual underground coal gasification symposium; Laramie, WY, USA (24 Aug 1987).

The Thirteenth Annual Underground Coal Gasification Symposium was cosponsored by the Morgantown Energy Technology Center's Laramie Projects Office and Gas Research Institute of Chicago, Illinois, and hosted by the Western Research Institute of Laramie, Wyoming. The symposium was held in Laramie, Wyoming, during the period, August 24 to 26, 1987. Papers printed in these Proceedings were reproduced from camera-ready manuscripts

furnished by the authors. They have not been refereed nor have they been edited after receipt for publishing. The purpose for this annual meeting is to provide an opportunity for scientists working in the technology to present their research results, exchange ideas, and discuss their future plans. Nearly 100 attendees from industry, academia, Government, and eight countries, including Belgium, Brazil, France, the Netherlands, Japan, West Germany, India, and Yugoslavia participated. Forty-seven papers were presented in five formal sessions covering Technology, International, Environmental, and General Topics and one informal poster session dominantly covering laboratory and modeling studies. Industrial papers have been processed for inclusion in the Energy Data Base.

46230 **(DOE/PC/79921—T3) Pore structure and reactivity changes in the hot coal gas desulfurization sorbents: Technical progress report for the period January--March 1988.** Sotirchos, S.V. (Rochester Univ., NY (USA). Dept. of Chemical Engineering). Apr 1988. Contract FG22-87PC79921. 22p. NTIS, PC A03/MF A01; 1; GPO Dep. Order Number DE88015037/JAW.

The primary objective of the project is the investigation of the structural and reactivity changes occurring in metal/metal oxide sorbents used for desulfurization of hot coal gas during sulfidation and regeneration, with particular emphasis placed on the effects of these changes on the sorptive capacity and efficiency of the sorbents. The following tasks have been identified in the project: (1) Conversion vs. time studies during sulfidation and regeneration; (2) Pore structure evolution studies during sulfidation and regeneration; (3) Intraparticle diffusion studies; (4) Development of structural models for hot coal gas desulfurization sorbents; and (5) Development of mathematical models for fixed-bed desulfurization reactors. During the fourth quarter of the 1987 calendar year, our research efforts primarily focused on Tasks 1 and 5. Preliminary reactivity experiments were carried out using the thermogravimetric analysis system that is available in our laboratory. Our experiments were conducted using zinc oxide (research grade) powder and air-hydrogen sulfide mixtures. Our experiments revealed a number of problems which we are currently trying to resolve. The fixed-bed desulfurization model that we developed during the previous reporting period was applied to the analysis of fixed-bed desulfurization reactors loaded with ZnO pellets. Our results showed that the pore size distribution of the ZnO pellets plays a major role in determining the transient behavior of the reactor and, therefore, the utilization of the sorbent per run. Reactors loaded with pellets of the same initial porosity and internal surface area may exhibit markedly different breakthrough times if the pore size distributions of the pellets are not the same. 15 refs., 3 figs., 1 tab.

46231 **(DOE/PC/79923—T2) The effect of chemical additives on the synthesis of ethanol: Technical progress report 2, December 16, 1987--March 15, 1988.** Chuang, S.S.C. (Akron Univ., OH (USA). Dept. of Chemical Engineering). 23 Apr 1988. Contract FG22-87PC79923. 11p. NTIS, PC A03/MF A01; 1; GPO Dep. Order Number DE88013087/JAW.

The objective of this research is to elucidate the role of various chemical additives on ethanol synthesis over Rh- and Ni-based catalysts. Chemical additives used for this study will include S, P, Ag, Cu, Mn, and Na, which have different electronegativities. The effect of additives on the surface state of the catalysts, heat of adsorption of reactant molecules, reaction intermediates, reaction pathways, reaction kinetics, and product distributions is/will be investigated by a series of experimental studies including temperature programmed desorption, infrared study of NO adsorption, reactive probing, steady state rate measurement, and transient kinetic study. A better understanding of the role of additive on the synthesis reaction may allow us to use chemical additives to manipulate the catalytic properties of Rh- and Ni-based catalysts for producing high yields of ethanol from syngas. During the second quarter of the project, the following tasks and research have been completed. A temperature programmed desorption system has been built and the system will be tested in the third quarter. Effect of sulfur on CO insertion over Rh/SiO_2 was studied. A series of $Ag-Rh/SiO_2$ catalysts was prepared for studying the structure sensitivity of CO insertion. 4 refs., 4 figs., 1 tab.

46232 **(DOE/PC/79928—T2) Solid superacids as coal liquefaction catalysts: Quarterly report, January-March 1988.** Tierney, J.W.; Wender, I. (Pittsburgh Univ., PA (USA). Dept. of Chemical and Petroleum Engineering). 1988. Contract FG22-87PC79928. 7p. NTIS, PC A02/MF A01; 1; GPO Dep. Order Number DE88013725/JAW.

This research is centered on the use of solid superacids as liquefaction catalysts. During this quarter, several metal oxide catalysts were synthesized. These include Fe_2O_3, ZrO_2, and TiO_2, each containing sulfate ions. Acidity measurements with Hammett indicators showed them to be in the superacidity range. 5 refs.

46233 **(DOE/PC/79938—2) Studies of coupled chemical and catalytic coal conversion methods: Second quarterly report, January, February, March, 1988.** Stock, L.M.; Miyake, M.; Flores, F. (Chicago Univ., IL (USA). Dept. of Chemistry). 1988. Contract AC22-87PC79938. 14p. NTIS, PC A03/MF A01; 1; GPO Dep. Order Number DE88013717/JAW.

This research is directed toward the discovery of a two step liquefaction process. The first step in the sequence will involve a very low severity chemical transformation of the coal that converts the wholely insoluble and intractable coal molecules into materials that are 70{endash}80{percent} soluble in conventional organic solvents. The second step in the sequence will involve catalytic dihydrogen addition to the solubilized coal macromolecules that will produce an even more freely soluble liquid product. Several considerations prompted us to begin our research with oxygen-poor coal. This tactic will enable us to assess the reactivity patterns of the carbon-rich macromolecules in the absence of the complicating phenolic substances. Considerable progress has been made on the assessment of the utility of non-reductive alkylation for solubilization in pyridine. A preprint {open+-quotes}Coal Solubilization—Factors Governing Successful C-Alkylation,{close+-quotes} which describes our recent accomplishments constitutes our report for this quarter.

46234 **(DOE/PC/80012—T10) Biological production of fuels from coal derived gases: Quarterly report, December 20, 1986-March 20, 1987.** (Arkansas Univ., Fayetteville (USA)). 1987. Contract AC22-85PC80012. 40p. NTIS, PC A03/MF A01; 1; GPO Dep. Order Number DE88012130/JAW.

Coal may be converted to a more convenient energy source and a valuable chemical feedstock by gasification and removing undesirable components. In most gasification processes, the coal is hydrogasified by adding steam and energy at 20-70 atm and at temperatures as high as 1500{degree}C. A gas consisting of more than 50 percent hydrogen and carbon monoxide is usually produced, having a heating value of about 450 Btu per SCF. In addition to carbon monoxide (CO) and hydrogen (H_2), small amounts of carbon dioxide (CO_2), methane (CH_4), hydrogen sulfide (H_2S), and carbonyl sulfide (COS) are also produced. The purpose of this research is to demonstrate the feasibility of producing liquid fuels from the components of synthesis gas through indirect biological liquefaction. Two tasks are to be undertaken in the two year study: a review of biological processes for synthesis gas conversion as shown in the literature; and microbiological screening studies aimed at finding organisms capable of carrying out the conversions. Organisms obtained from both pure cultures or natural bacterial sources such as sewage sludge, animal wastes, and coal pile mud will be evaluated and screened. Results are presented. 19 refs.

46235 **(DOE/PC/80023—T13) Development of an in-situ hydrogen measuring instrument for coal liquefaction processes: Quarterly report, April--June 1988.** Klinzing, G.E. (Pittsburgh Univ., PA (USA). Dept. of Chemical and Petroleum Engineering). 1988. Contract AC22-85PC80023. 22p. NTIS, PC A03/MF A01; 1; GPO Dep. Order Number DE88014670/JAW.

The objective of the project is to determine 1) hydrogen solubility in tetralin under the presence of ethane and methane. 2) Hydrogen mass transfer rate measurement of hydrogen-tetralin-ethane systems; 3) The rate and quantification of dehydrogenation of donor solvent liquids. A probe was designed to measure the amount of hydrogen released when donor solvent liquids were exposed to

liquefaction conditions of high temperature and pressure, During this quarter, nickel tubing of the probe was replaced by stainless steel-310, which is more resistant to HS attack. Also, the permeation rate (of hydrogen) of the steel was 8 times slower than that of the nickel probe {approximately} 670K. 10 figs., 6 tabs. (CBS)

46236 **(DOE/PC/80910—T3) A study of depolymerization and crosslinking reactions in coal liquefaction: Tenth quarterly report, December 1, 1987-February 28, 1988.** Solomon, P.R.; Deshpande, G.V.; Serio, M.A. (Advanced Fuel Research, Inc., East Hartford, CT (USA)). 1988. Contract FG22-85PC80910. 21p. NTIS, PC A03/MF A01; 1; GPO Dep. Order Number DE88013177/JAW.

The major goal of this program is to characterize the depolymerization and crosslinking reactions of low rank coals and determine how they can be optimized in liquefaction by combining high heating rates with solvent interactions. High heating rates are achieved by using a heated tube reactor where coal is heated at about 20,000{degree}C/sec. Solvent interactions to stabilize depolymerization fragments formed at high heating rates are achieved by: 1) co-injection of a donor solvent into the heated tube reactor, 2) preswelling the coal at elevated temperatures (100{degree}C) and pyrolyzing the swelled coal in the heated grid or heated tube reactors; and 3) injecting rapidly preheated coal into a hot solvent. Crosslinking and depolymerization reactions are also being studied by using polymers to simulate the chemistry occurring in coal. Construction of the high pressure liquefaction reactor system was completed. Several modifications were done to the original design. The initial set of experiments will be carried out to elucidate the rank dependence and the chemical modification of crosslinking chemistry on liquefaction yields. The FG-DVC model which has been used for coal pyrolysis was modified for liquefaction. The dissolution of coal was assumed to be instantaneous and hydrogen was donated by solvent during bond breaking. The crosslinking reaction was assumed to be taking place with CO_2 and CH_4 evolution. Initial results suggest that the amount of liquefaction products are underpredicted for low rank coals. It may be due to reduced rate of crosslinking during liquefaction because the crosslinks could be capped by hydrogen from the donor solvent. Experimental studies are in progress to validate this hypothesis. The current model is also being modified to account for solid-liquid mass transfer during liquefaction. 3 refs., 6 figs., 4 tabs.

46237 **(DOE/PC/80910—T4) A study of depolymerization and crosslinking reactions in coal liquefaction: Eleventh quarterly report for the period March 1, 1988--May 31, 1988.** Solomon, P.R.; Deshpande, G.V.; Serio, M.A.; Kroo, E. (Advanced Fuel Research, Inc., East Hartford, CT (USA)). 1988. Contract FG22-85PC80910. 16p. NTIS, PC A03/MF A01; 1; GPO Dep. Order Number DE88015497/JAW.

The major goal of this program is to characterize the depolymerization and crosslinking reactions of low rank coals and determine how they can be optimized in liquefaction by combining high heating rates with solvent interactions. High heating rates are achieved by using a heated tube reactor where coal is heated at about 20,000 {degree}C/sec. Solvent interactions to stabilize depolymerization fragments formed at high heating rates are achieved by: co-injection of a donor solvent into the heated tube reactor, preswellling the coal at elevated temperatures (100{degree}C) and pyrolyzing the swelled coal in the heated grid or heated tube reactors and injecting rapidly preheated coal into a hot solvent. Crosslinking and depolymerization reactions are also being studied by using polymers to simulate the chemistry occurring in coal. In order to determine the rank dependence of liquefaction yields, experiments were carried out with North Dakota Zap lignite and Pittsburgh Seam bituminous coal at 400{degree}C and reaction times up to 30 minutes. The conversion to toluene solubles for the bituminous coal was found to be higher than the lignite. A strong dependence of temperature on the conversion to toluene solubles was observed for both the lignite and the bituminous coal. To assess the influence of the liquefaction solvent on the crosslinking of Zap lignite, chars were made in the presence of tetralin or helium at different temperatures. The coal was heated in an electrically heated tube reactor to the desired temperature and the temperature was held for 3 minutes. The crosslinking curve shifted to higher temperatures for the same loss in swelling for the chars formed in the presence of tetralin. Hence the presence of a hydrogen donor solvent like tetralin reduces the rate and extent of the crosslinking reactions. The mechanism may be capping some of the crosslinking sites with hydrogen donated by the tetralin. 4 refs.

46238 **(DOE/PC/90910—6) Enhanced coal liquefaction by low-severity catalytic reactions: Technical progress report for the period March to May 1988.** Davis, A.; Schobert, H.H.; Derbyshire, F.J. (Pennsylvania State Univ., University Park (USA)). Jun 1988. Contract FG22-86PC90910. 54p. NTIS, PC A04/MF A01; 1; GPO Dep. Order Number DE88013183/JAW.

Impregnated Mo, Fe, or Fe + Mo catalysts were used to liquefy an hvC bituminous coal (PSOC-1943) in the presence and absence of a low-boiling recycle solvent under conditions of increasing severity. It was found that, for these reaction conditions, the bi-metallic catalyst was very active. Reactions conducted in the absence of solvent showed that 1% Fe + 0.1% Mo was much more active that 1% Fe and nearly as active as 1% Mo, based on total conversion and hydrogen consumption. Similarly, liquefaction in the presence of solvent has shown that the mixed catalyst results in consumption of the greatest amount of hydrogen gas and produces the largest conversion of the coal mass to soluble liquids. Comparisons of catalytic liquefaction performed in a one-step sequence at high severity, and in two-step sequences from low-to-high and high-to-low severity conditions, has confirmed that there are distinct advantages in liquefying coal in stages of increasing temperature. The application of polymer theory to the insoluble liquefaction residues and a consideration of total conversion and hydrogen utilization suggest that the various catalytic materials are acting on the coal through different mechanisms. Characterization of catalyst precursor, catalyst liquefaction residues and catalyst remnants found in coal liquefaction residues is continuing. 31 refs., 12 figs., 9 tabs.

46239 **(DOE/PC/90912—T5) Low-severity coal liquefaction to determine reactivity of coals: Final technical report for the period June 24, 1986-April 23, 1988.** Chung, Kwang E.; Heredy, L.A. (Rockwell International Corp., Thousand Oaks, CA (USA). Science Center). May 1988. Contract FG22-86PC90912. 34p. NTIS, PC A03/MF A01; 1; GPO Dep. Order Number DE88010827/JAW.

The reactivity of three coals, Illinois No. 6 bituminous, Ohio No. 6 bituminous, Wyoming Canyon-Top subbituminous, with H_2 has been investigated at high pressure (2700{endash}2900 psig), but mild liquefaction temperatures (300{endash}350{degree}C). Changes in conversion and product distribution as a function of time, temperature, donor solvents and catalysts were determined. The reactivity of dry coal with H_2 was found to be high at the mild temperatures employed. At 325{degree}C, the conversion of the Illinois coal to gaseous and soluble products increased with reaction time up to 14 h. The reactivity of the Ohio coal was similar to that of the Illinois coal; however, the Wyoming subbituminous coal was much less reactive. With the bituminous coals, the major reactions of the oxygen functional groups at 325{degree}C are with hydrogen if it is sufficiently available at reaction sites. The large difference in reactivity between subbituminous and bituminous coals studied is hypothesized to be due to more extensive retrograde reactions at the sites of oxygen linkages in the subbituminous coal when hydrogenation is not fostered by an effective catalyst. The coal-H_2 reaction was catalyzed by MoS_2. In particular, the conversion of Wyoming coal was promoted, increasing three-fold at 325{degree}C and oil yield increased five-fold. Under the same conditions, MoS_2 increased conversions of the two bituminous coals by 20{percent} and increased oil yields by 50{percent}. Pyrite, however, was not catalytic at mild temperatures, but instead showed an adverse effect on dry hydrogenation of the bituminous coals, leading to large decreases in conversion and oil yield. Two hydrogen-donor solvents 9.10 dihydrophenanthrene and prehydrogenated fluorathene, known to be effective at higher temperatures also had detrimental effects on the direct hydrogenation of coal when added in a 2:1 ratio. 2 refs., 18 figs., 17 tabs.

46240 **(DOE/RL/01830—2520) Ammonia removal in coal gasification processes by adsorption on zeolites: Final report.** Baker, E.G.; Roberts, G.L.; Mudge, L.K. (Pacific Northwest Lab., Richland, WA (USA)). Nov 1987. Contract AC06-76RL01830. 26p. NTIS, PC A03/MF A01; 1; GPO Dep. Order Number DE88001094/JAW.

The objective of this research project was to evaluate NH_3 removal from hot coal-derived gases by adsorption on zeolites. Zeolites, because of their properties as solid acids, can adsorb certain compounds by chemical bonding on the acids sites. Chemisorption is slower than physical adsorption but can take place at higher temperatures. Ammonia is one of the many compound known to chemisorb on zeolites. Studies were conducted in a 100-cc, fixed-bed, continuous-flow, catalytic reactor. A simulated coal gas containing 5000 ppM NH_3 (0.5 vol%) was used. A gas chromatograph equipped with a photoionization detector was used to analyze for NH_3 in the inlet and outlet gases. The study showed that NH_3 will adsorb on zeolites at high temperatures. Hydrogen mordenite was the most effective zeolite for adsorbing NH_3 at 550{degree}C and 10 atm. With a dry feed gas a H-mordenite zeolite removed over 95% of the NH_3 from the gas until the NH_3 loading on the zeolite reached about 1 wt% at breakthrough. 15 refs., 10 figs., 8 tabs.

46241 **(EPRI-AP—5893) Treatability testing of KILnGAS and Texaco coal gasification wastewaters: Final report.** Peterson, D.L.; Eis, B.J.; Zeien, C.T.; Moe, T.A.; Turner, C.D.; Mayer, G.G.; Stephan, D.J. (Electric Power Research Inst., Palo Alto, CA (USA); CH2M Hill, Bellevue, WA (USA); North Dakota Univ., Grand Forks (USA). Energy and Mineral Research Center). Jul 1988. 233p. Unlimited audience, publicly available. Research Reports Center, Box 50490 Palo Alto, CA 94303. Order Number TI88013639/JAW.

This report presents the results of treatability testing of wastewater from two coal gasification plants: the 600-tpd KILnGAS rotary-kiln gasifier in East Alton, Illinois, and the 1000-tyd Texaco entrained-flow gasifier at the Cool Water facility in Daggett, California. The wastewater was collected during steady-state operation of the gasifiers and shipped in barrels to the testing laboratory for characterization and treatment. Solvent extraction, steam stripping, biological treatment, granular activated carbon adsorption, ozonation, ion exchange, chemical precipitation, cooling tower evaporation, and wet air oxidation were evaluated in terms of their ability to meet the project's effluent quality targets. Preliminary process design criteria were also developed. Two sets of effluent discharge targets as well as a zero effluent discharge condition were established as goals for the testing. All of the effluent targets were met by the combination of processes used in the treatability testing program, with the exception of cyanide and COD for the KILnGAS wastewater and cyanide under one of the discharge conditions for the Texaco wastewater. These targets could likely be met by additional process steps or by further treatment with the processes tested. This test program confirmed that the principal containmants in these coal gasification wastewaters can be reduced to low concentrations by use of commercially proven treatment processes. 15 refs., 50 figs., 93 tabs.

46242 **(LBL—25041) Fundamental studies of catalytic gasification: Quarterly report, January 1, 1988-March 31, 1988.** Heinemann, H.; Somorjai, G.A. (Lawrence Berkeley Lab., CA (USA)). Mar 1988. Contract AC03-76SF00098. 16p. NTIS, PC A03/MF A01; 1; GPO Dep. Order Number DE88014049/JAW.

Steam gasification was performed on both graphite and demineralized char. Mixtures of earth alkali with potassium as catalysts exhibited good gasification characteristics. K-Mg is the most active and only somewhat less active than K-Ni. K-Ca is less active than K-Mg. The alkali-earth alkali catalysts show less initial deactivization and greater stability than K-Ni. The alkali-earth alkali mixtures can dissociate water at the operating temperatures (>800k). An additional factor in catalyst activity is the ability of the catalyst to wet and spread over the carbon surface. This is dependent on the melting point of the mixture which is lower for K-Mg and for K-Ni than for a Mg-Ni mixture. A previously proposed reaction scheme is expanded and is supported by experimental work. 4 refs., 5 figs., 2 tabs.

46243 **(UCRL—98640) Data acquisition system and instrumentation for the Rocky Mountain I Coal Gasification test.** Metzger, G.A.; Britten, J.A. (Lawrence Livermore National Lab., CA (USA)). Aug 1988. Contract W-7405-ENG-48. 12p. (CONF-880874—1). NTIS, PC A03/MF A01; 1; GPO Dep. Order Number DE88015450/JAW.

From 14. annual underground coal gasification symposium; Schaumburg, IL, USA (15 Aug 1988).

Lawrence Livermore National Laboratory (LLNL) designed the data acquisition system (DAS) to measure all surface and subsurface process parameters during the Rocky Mountain I (RM I) Underground Coal Gasification (UCG) test. The Hewlett Packard (HP) minicomputer-based system acquired data from strings of type-K thermocouples that were emplaced in vertical wells at key locations in the reactor area. Process data such as injection and production flow rates, temperatures, and pressures were also measured and stored by the DAS. In addition, the gas analysis data from gas chromatographs and the mass spectrometer were logged throughout the test. An improved method of measuring the water to dry gas ratio was also developed and utilized for the RM I test. It consisted of a proven hydrostatic liquid level measurement technique and a novel purge method thus producing water/dry data that was considerably improved in both accuracy and frequency of measurement. An additional diagnostic instrument added to the CRIP injection liner and a VIW1 dip tube was a stainless teel jacketed twisted pair of copper wires whose lengths were measured using a time domain reflectometer (TDR) technique. The measurement of the cable lengths would be correlated to the length of the liner and dip tube over the duration of the test. This measurement combined with thermocouple data was used to model cavity growth. Early indications are that a number of subsurface thermocouples may have burst because of gas buildup in the sheath. Many may have failed before they actually saw a critical process temperature. Future use of any sheath type thermocouples will require acceptance testing and vendor qualification to preclude this type of failure. Future UCG tests will require the use of cost-effective and reliable subsurface diagnostics, such as the TDR technique combined with thermocuples, to characterize the dimensions, position, and movement of the underground burn cavity. 7 refs., 8 figs.

0105 By-products

46244 **(EUR—10992-EN) Research study contract - coal based ironmaking.** Smith, R.B.; Corbett, M.J. (Commission of the European Communities, Luxembourg). 1987. 180p. Commission of the European Communities, Luxembourg.

In Europe, Japan and elsewhere, considerable efforts are being devoted to the development of a new generation of processes which are designed to produce liquid iron economically at low capacity and use coal, particularly non-coking coal. Therefore these developments have been studied and evaluated in detail directly during the period between 1 January 1985 and 30 September 1985. This final report introduces the new developments, describes the process concept, flow-sheet and current status of each of the significant process developments, gives a technical analysis of the types of process configurations being developed, and presents economic analyses and comparisons between the various processes. Information on each of the developments has been collected by literature surveys, correspondence and visits to and discussions with the process developers. On the basis of the information collected and the technical analyses carried out, conclusions are drawn on the probable impact of the new technologies in different economic scenarios, and recommendations for further technical development efforts within Europe are proposed.

0106 Properties

REFER ALSO TO CITATION(S) 46221, 46222, 46232, 46260, 46261, 46262, 46263, 46264, 46265, 46266, 46267, 47035

46245 (DOE/PC/70782—12) Electron spin mapping of coal molecular structure by ENDOR: Quarterly technical progress report. Belford, R.L. (Illinois Univ., Urbana (USA)). 15 Jul 1987. Contract FG22-84PC70782. 14p. NTIS, PC A03/MF A01; 1; GPO Dep. Order Number DE88013127/JAW.

The majority of EPR simulation optimizations reported have been least- squares fitting procedures. Least-squares fitting and many of the other common optimization methods require the calculation of derivatives of the simulation function with respect to the parameters being optimized. The need to calculate these derivatives limits programs based on these methods to the optimization of specific spectral parameters. For this reason, these optimization procedures are useful only for a set of closely related spectra. We have developed an optimization procedure based on the simplex method, which does not require derivatives. After an initial guess is made for the spectral parameters, the optimization procedure repetitively creates a simulation, compares it to the experimental spectrum, and calculates new spectral parameters based on the results of all the previous simulations in the optimization. We have had very good success with this method on a variety of EPR, ENDOR, and ESEEM spectra. The optimization procedure is described in this report in detail and examples of its use on the optimization of ENDOR spectral parameters are presented. The results show the optimization of anisotropic hyperfine coupling constants and linewidths of aromatic hydrocarbon cations adsorbed in activated silica-alumina. 13 refs.

46246 (DOE/PC/70782—14) Electron spin mapping of coal molecular structure by ENDOR [Electron-Nuclear Double Resonance]: Quarterly technical progress report. Belford, R.L. (Illinois Univ., Urbana (USA)). 15 Jan 1988. Contract FG22-84PC70782. 10p. NTIS, PC A02/MF A01; 1; GPO Dep. Order Number DE88013129/JAW.

In any paramagnetic material the unpaired electrons interact with those neighboring nuclei having non-zero moments. In electron spin echo (ESE) spectroscopy these interactions manifest themselves as modulations in the echo decay envelope, commonly called electron spin echo envelope modulation (ESEEM). Comparison of 2-pulse ESEEM spectra from the vitrinite component of Illinois #6 coal taken at X-band and S-band shows modulation is difficult to discern in the X-band spectrum but is readily apparent in the S-band spectrum. Calculations show that the modulation depth at S-band is roughly 9 times the depth at X-band as expected. Gamma-irradiated quartz was the first sample the investigators examined because it exhibits strong echoes even at room temperature. Extremely weak modulations appear in the S-band ESEEM spectrum of gamma-irradiated quartz. They have attributed this modulation to an interaction with ^{29}Si. They believe this to be the first observation of modulation from ^{29}Si in natural abundance. The results obtained so far support their expectations of deeper modulation from the S-band spectrometer. While the modulation depth for the samples studied is deeper at the lower field this will not always be the case. Whenever possible, spectra obtained at two or more fields are desirable to allow one to verify the uniqueness of parameters obtained at one field by simulating the spectrum at another field. Even when the modulation is deeper at the lower field, the higher field spectrum may provide more information if the echo decays very rapidly because the modulation periods increase at the lower fields. This limitation of lower field ESEEM may be overcome if the relaxation times are increased by decreasing the temperature. 4 figs.

46247 (DOE/PC/70782—15) Electron spin mapping of coal molecular structure by ENDOR [Electron-Nuclear Double Resonance]: Quarterly technical progress report. Belford, R.L. (Illinois Univ., Urbana (USA)). 15 Apr 1988. Contract FG22-84PC70782. 11p. NTIS, PC A03/MF A01; 1; GPO Dep. Order Number DE88013130/JAW.

In any paramagnetic material the unpaired electrons interact with those neighboring nuclei having non-zero moments. In electron spin echo (ESE) spectroscopy these interactions manifest themselves as modulations in the echo decay envelope, commonly called electron spin echo envelope modulation (ESEEM). The frequencies, intensities, and decays of these modulations give information about the types and number of nuclei as well as the interaction distances for the nuclei. Here we report low-frequency matrix modulations, not attributable to deuterium, in two different disordered systems {endash}a whole coal and perylene radical adsorbed on a powdered alumina surface. We believe these to be the first reports of ESEEM by ^{13}C in natural abundance and by ^{27}Al in disordered systems observed by stimulated (3-pulse) echos. 24 refs., 4 figs.

46248 (DOE/PC/79919—3) Flotation and flocculation chemistry of coals and oxidized coals: Technical progress report, March 15, 1988–June 15, 1988. Somasundaran, P. (Columbia Univ., New York (USA)). 1988. Contract FG22-87PC79919. 18p. NTIS, PC A03/MF A01; 1; GPO Dep. Order Number DE88015033/JAW.

A novel technique based on the centrifugal force required to detach particles from the liquid/vapor interface has independently established the existence of surface energy distribution in coal. In addition film flotation of coal and polymer treated coal samples from various points on the partition curves shows that the observed heterogeneity and surface energy distribution are representative of single coal particles. Cationic and nonionic polyacrylamide adsorption on coal was studied along with film flotation of coal samples treated with these polymers. Surface energy distribution spectra constructed from cumulative partition curves obtained by film flotation reveals useful new information on possible conformations of the adsorbed polymers. Adsorption of PAM on coal occurs by hydrogen bonding and hydrophobic interaction leading to nitrated hydrocarbon and amide surfaces respectively. In the case of CAPM treated coal the surface comprises of 30% amide groups, 20% water, bound to adsorbed polymer and 10% to 15% nitrated hydrocarbons.35% of the surface of coal treated with NPAM consists of water of hydration and 20% nitrated hydrocarbon. The observed decrease in hydrophobicity is due to the water of hydration along with adsorbed polymer molecules. 11 refs., 7 figs.

46249 (DOE/PC/80508—8) Two dimensional and zero field NMR studies of coal structure: Final progress report, including the period July 1, 1987 to September 30, 1987. Zilm, K.W. (Yale Univ., New Haven, CT (USA). Dept. of Chemistry). Dec 1987. Contract FG22-85PC80508. 9p. NTIS, PC A02/MF A01; 1; GPO Dep. Order Number DE88013575/JAW.

This report covers the progress made on the title project during the last quarter and summarizes the accomplishments for the project period. During the last three months we have completed a full analysis of the limitations of our ADIPSHIFT 2D NMR experiment that we have developed to determine the distribution of functional types of carbon in coals. This is an extensive piece of work and will provide a firm foundation for the application of the method to complex organic solids in the future. A particularly useful graphical analysis is described for use with unknowns such as coals. 17 refs.

46250 (INIS-BR—1164, pp 33) Study of the porosity and fractal geometry of the thermally treated vegetal coal. Sousa, J.C. de; Torrianni, I.L.; Luengo, C.A. (Universidade Estadual de Maringa (Brazil); Universidade Estadual de Campinas (Brazil). Inst. de Fisica). 1987. (In Portuguese). NTIS (US Sales Only), PC A09/MF A01. Order Number DE88703566/JAW. (CONF-8705181—).

From 10. national meeting on condensed matter physics; Caxambu, Brazil (5 May 1987).

46251 (NZERDC—150) Vegetation-lithotype correlations in New Zealand lignites. Holden, A.M. (New Zealand Energy Research and Development Committee, Auckland). Nov 1987. 95p. New Zealand Energy Research and Development Committee, Auckland.

New Zealand South Island lignites show distinct lithotype banding. Overseas, investigations have indicated that brown coal lithotypes can be correlated with different plant communities on

the basis of the plant fossils they contain. In an attempt to assess whether this is also true of New Zealand lignites, spot samples were taken from recognisable horizons in lignite seams exposed in five open-cast mines in Southland and Central Otago. Analysis of the mega fossil assemblages in relation to lithotype indicated that there was a relationship between macroscopically determined lithotype and plant content in some cases. Cluster analysis divided the samples into two major groups, one containing the light and medium-light horizons and the other the dark, fibrous and dark woody lithotypes. The depositional environment of the lithotypes is then discussed.

46252 (PNL-SA—15217, pp 49-61) **Methods for separating chemical classes of coal-liquefaction materials.** Wright, C.W.; Chess, E.K.; Lucke, R.B.; Weimer, W.C.; Later, D.W.; Mahlum, D.D.; Stewart, D.L.; Wilson, B.W. 1987. NTIS, PC A99/MF A01. Order Number DE88007332/JAW. (CONF-851027—).

From 24. Hanford life sciences symposium and environmental research on complex organic mixtures; Richland, WA, USA (20 Oct 1985).

Methods were developed to separate aliphatic hydrocarbons, polycyclic aromatic hydrocarbons (PAH), nitrogen-containing polycyclic aromatic compounds (NPAC), and hydroxy-substituted PAH from complex coal-liquefaction matrices by alumina column chromatography. Distillation prior to column chromatography has been used as another means to reduce the chemical complexity of coal-liquefaction materials. Microbial and initiation/promotion assays on fractions showed that most mutagenicity was associated with NPAC fractions, while most tumorigenicity was associated with PAH fractions. The NPAC fractions were separated into secondary amine (carbazoles,), primary aromatic amine (amino-substituted PAH), tertiary amine (azaarene), and cyano-substituted PAH subfractions by column chromatography. Most microbial mutagenicity was isolated in the amino-substituted PAH subfraction. The PAH (and hydroxy-PAH) fractions were subfractionated by molecular weight using reverse-phase high-performance liquid chromatography (HPLC). The PAH fraction tumorigenicity was not concentrated in any one HPLC subfraction. As coal-liquefaction processes have evolved, the products have become more highly alkylated and hydrogenated. Hydroaromatic species in coal liquefaction materials have been separated from PAH species by picric-acid-coated alumina column chromatography. Hydroaromatic species showed little to no mutagenic or tumorigenic response.

46253 (PNL-SA—15217, pp 75-93) **Chemical and toxicological characterization of neutral components in complex energy-related mixtures.** Stamoudis, V.C.; Haugen, D.A.; Heffley, P.D.; Picel, K.C. (Argonne National Lab., IL (USA)). 1987. NTIS, PC A99/MF A01. Order Number DE88007332/JAW. (CONF-851027—). Contract W-31-109-ENG-38.

From 24. Hanford life sciences symposium and environmental research on complex organic mixtures; Richland, WA, USA (20 Oct 1985).

The authors isolated, subfractionated, and characterized the neutral components of byproduct tars from two coal gasifiers and a reference coal-derived oil, using standardized procedures. Neutral fractions, obtained by liquid/liquid partitioning, were chromatographed on silica columns to yield four subfractions, which contained primarily aliphatic hydrocarbons, aromatic hydrocarbons, neutral nitrogen heterocycles (indoles and carbazoles), and polar-neutral compounds. Detailed chemical analysis of all fractions was performed by computer-assisted capillary-column gas chromatography (GC). Complementary analysis of certain fractions was performed by GC/mass spectrometry (GC/MS) and GC/Fourier-transform/infrared spectroscopy (GC/FTIR). Mutagenicities of neutral fractions and subfractions were determined in the Ames Salmonella/microsome assay. Most mass and mutagenicity was recovered in aromatic and polar-neutral fractions. Recovery of over 100% mutagenicity in the aromatic fraction indicates that mutagenic activity of polynuclear aromatic hydrocarbons (PAH) was masked by other components in the original neutral fraction. Aromatic (mostly PAH) and neutral nitrogen heterocycle (indoles and carbazoles) fractions of all three coal-derived materials were qualitatively similar but differed somewhat quantitatively. Aliphatic fractions of by-product coal-gasifier tars contained primarily n-alkanes and terminal n-alkenes; the coal oil did not contain alkenes. The most notable differences in composition (and mutagenicity) were encountered in polar-neutral fractions, which contained primarily cyclopentenones, indanones, acetophenones, cyanoaromatics, and alkylated phenols in gasifier tars, but only alkylated phenols in coal oils.

46254 (PNL-SA—15217, pp 223-249) **Engineering, chemical, and biological evaluation of oils and tars produced under varying coal-devolatilization conditions.** Fillo, J.P.; Stamoudis, V.C.; Craun, J.C.; Reilly, C.A. Jr. (Argonne National Lab., IL (USA)). 1987. NTIS, PC A99/MF A01. Order Number DE88007332/JAW. (CONF-851027—). Contract W-31-109-ENG-38.

From 24. Hanford life sciences symposium and environmental research on complex organic mixtures; Richland, WA, USA (20 Oct 1985).

The effects of process conditions on the yield, chemical composition, and toxicological characteristics of oils and tars produced during devolatilization of coal were studied. Forty-nine experiments were conducted, using lignite and subbituminous coal. Gas chromatographic analysis of the complex oil and tar by-products identified more than 100 organic compounds, and a nitrogen-specific detector identified several nitrogen-bearing organic compounds. Reactor condensate samples, including tar, oils, and aqueous materials, were screened using the Ames Salmonella assay. The yield, chemical composition, and mutagenicity of by-product oils and tars varied substantially. Yields generally decreased as reactor temperature increased from 600°C to 1000°C, but the highest yields occurred at 800°C with a 0.2-sec residence time in the presence of steam. The chemical composition of bulk oil-tar mixtures varied considerably. At 600°C, a complex mixture of mostly phenols, furans, and nonchromatographable compounds was produced. At 1000°C, most one- to four-ring aromatics were produced; low levels of phenols and alkylated derivatives were also present. The highest values of mutagenicity were measured for oil and tar mixtures produced at 800°C; by-products produced at 600°C exhibited low or statistically insignificant mutagenicity.

46255 **Quantitative determination of different carbon types in fusinite and anthracite coals from carbon-13 nuclear magnetic resonance chemical shielding line-shape analysis.** Sethi, N.K.; Pugmire, R.J.; Facelli, J.C.; Grant, D.M. (Univ. of Utah, Salt Lake City (USA)). *Analytical Chemistry;* 60: No. 15, 1574-1579(1 Aug 1988). Contract FG02-86ER13510.

^{13}C NMR shielding tensors have been determined for two anthracite coals and a fusinite maceral by using powder pattern line shapes which have been analyzed as a superposition of three different bands due to benzenelike, condensed (bridgehead and inner) and substituted carbons. Theoretical calculations on circumcoronene (I) as a model compound support the interpretations of the experimental data. Determination of the ratio of nonprotonated to protonated aromatic carbons obtained on the anthracites by the spectroscopic analysis is in excellent agreement with the elemental analysis and previous studies by dipolar dephasing NMR techniques. The method therefore constitutes a valuable way to analyze the structure of high rank coals and should be useful in char characterization. The mole fraction of condensed carbons obtained by this technique is used to estimate the average cluster size in these polycondensed aromatic hydrocarbon materials.

0108 Waste Management

46256 (DOE/PC/70771—T9) **Kinetics of nitrogen and sulfur reactions in combustion systems: Quarterly report No. 11.** (Energy and Environmental Research Corp., Irvine, CA (USA)). [1988]. Contract AC22-84PC70771. 91p. NTIS, PC A05. Order Number DE88012962/JAW.

Four segments of the contract "Kinetics of Sulfur and Nitrogen Reactions in Combustion Systems" are summarized in this report: 1. Results of recent kinetic modeling studies of advanced applications of additives for NO/sub x/ control-side chamber design studies. 2. Status of fundamental laboratory experiments investigating the potential of several compounds for NO/sub x/ control in combustion systems. 3. Development status of the inert cal-

cimer for SO_3 sorbent preparation. 4. An update on fundamental studies of sorbent calcination kinetics. The overall program is designed to support one goal: Develop the crucial fundamental mechanistic and quantitative rate information on the chemistry of formation and control of sulfur and nitrogen oxides as they pertain to pulverized coal fired systems. Separate abstracts were prepared for each section, and entered in the Energy Data Base.

46257 **(RISO-M—2666) Sulphur dioxide reduction in fluidized bed combustion. Part 1. Investigation of limestone for flue gas desulfurization in fluidized beds.** Hansen, L.K.; Jensen, A.; Ottosen, P.; Olsen, A. (Risoe National Lab., Roskilde (Denmark)). Oct 1985. 78p. NTIS (US Sales Only), PC A05/MF A01. Order Number DE88754085/JAW.

Reduction of sulphur dioxide in flue gas in fluidized beds by adding limestone has been investigated. 14 different types of limestone have been tested in a laboratory facility. 4 types have been selected for a test in Risoes 300 kW fluidized bed, and 3 types have been tested in dk-TEKNIKs 1MW fluidized bed. Finally one type has been tested in a 12 MW fluidized bed in a district heating station located in Skanderborg. This report describes the laboratory test programme.

0109 Environmental Aspects

REFER ALSO TO CITATION(S) 46528, 47324

46258 **(DOE/PE/16037—T4) The environmental threshold concept: Use and potential impacts on federal coal development and energy facility siting on federal land in the West: Final report.** (Eastern Research Group, Inc., Arlington, MA (USA)). 14 Jul 1987. Contract AC01-84PE16037. 199p. NTIS, PC A09. Order Number DE88012307/JAW.

This report examines the use of the threshold concept and cumulative effects analysis in the Bureau of Land Management's Federal Coal Management Program (FCMP). The idea of evaluating the cumulative effects of potential coal mine (or other) development in relation to an established threshold of acceptable environmental impact has been part of the FCMP since it was first established in 1979. However, the approach, as defined by regulations implementing the FCMP, has been little used. 100 refs., 25 figs., 34 tabs.

46259 **Infiltration capacity of disturbed soils: temporal change and lithologic control.** Jorgensen, D.W.; Gardner, T.W. (Colorado State Univ., Fort Collins (USA)). *Water Resources Bulletin;* 23: No. 6, 1161-1172(Dec 1987). Contract FG02-84ER60263.

The hydrologic character and response of disturbed land is controlled, to a large degree,by soil infiltration characteristics. Reconstructed soils on surface mines (mine soils) of different age (1 to 4 years old) are used to investigate infiltration rates on disturbed landscapes. The data consist of soil/surface properties and runoff volumes fit to the Horton infiltration equation. Infiltration rates on newly reclaimed mine soils are an order of magnitude lower than adjacent, undisturbed soil. Few significant correlations exist between soil/surface properties and infiltration parameters for newly reclaimed soils. However, the correlation between infiltration and mine soil characteristics increases with soil age. Multiple regressions are used to explore relationships between infiltration parameters and soil/surface properties for each soil age. Regression models of 30-min infiltration volume and the steady-state rate consistently include the percent silt and clay, slope, bulk density, and vegetation. Mean infiltration volumes at different mines are equal in the first year following reclamation, but become significantly different with surface age. The magnitude of the increase is controlled by the soil texture, vegetation, slope, and bulk density. Soil characteristics are determined ultimately by the overburden lithology and its effect on mineralogy and grain size during physical redistribution of soil particles and initial weathering.

0110 Reserves And Exploration

46260 **(GTK-TURVE—207) Peat Surveys in Vuolijoki.** Haeikioe, J.; Porkka, H. (Geological Survey of Finland, Kuopio). 1987. 227p. (In Finnish). NTIS (US Sales Only), PC A11. Order Number DE88754071/JAW.

The Geological Survey of Finland made an inventory of the peat resources in the municipality of Vuolijoki. Altogether 35 bogs converting a total area of 9945 hectares were studied. The field work was carried out using survey line grids with study sites at the intervals of 100 meters. At each site the cover type, the peat type and the decompostion degree of peat as well as portion of dead, undecomposed trees in the deposits, were determined and recorded. Altogether 596 peat samples were taken to the laboratory for pH, water content and ash content determinations. Heating value was determined for 242 samples, sulphur content for 149 samples and behavior of the peat ash melting for 57 samples. 2063 hectares of peatland was considered good for fuel peat production. The quantity of usable peat is 31.47 million cubic meters in situ. Its dry matter content is 2.88 tons and the energy content of the usable peat is 67.2 million GJ or18.7 million MWh.

46261 **(GTK-TURVE—208) Peat resources of Naerpioe and their pontential use.** Toivonen, T. (Geologian Tutkimuskeskus, Espoo (Finland)). 1988. 273p. (In Finnish). NTIS (US Sales Only), PC A12. Order Number DE88754072/JAW.

The Geological Survey of Finland studied peat resources in the commune of Naerpioe in 1982 and 1984. 56 bogs covering a total area of 9762 hectares were studied. This is more than 95% of the total peatland area. The bogs studied contain a total of 138,5 milliion m"3 of peat in situ. The mean depht of the bogs is 1.42 m, including the poorly humified surface layer, which averanges 0.86 m in thickness. The mean humification degree (1-10 scale) of the peat is 4.3. The area deeper than 2 m covers 2570 ha and contains 49% of the total peat quantity (67.8 million m"3). Seventy seven per cent of the peat is Sphagnum predominant, and the remaining 23% Carex predominant. More than half of the bogs are drained. The most common sit type is Sphagnum bog with pines. The average ash content of peat is 2.7% of dry weight, the water content 92,5% of wet weight, the dry bulk density 74 kg per m"3 in situ, and the sulphure content 0.135 of dry weight. The effective calorific value of the dry peat is 19.2 MJ/kg. Twenty nine bogs are suitable for horticultural peat production. The total area suitable for peat production is 1049 ha and the available amount of peat is 25.0 milj. m"3 in situ. Only five bogs are suitable for fuel peat production. The suitable area is 402 ha. The available amount of peat is 8.0 million m"3 in situ and the energy content at 50% moisture 2.9 million MWh.

46262 **(GTK-TURVE—209) Peat surveys in Pieksaemaeki.** Leino, J. (Geological Survey of Finland, Kuopio). 1988. 273p. (In Finnish). NTIS (US Sales Only), PC A12. Order Number DE88754073/JAW.

The Geological Survey of Finland made an inventory of the peat resources in the municipality of Pieksaemaeki in 1983 and 1984. Altogether 3777 hectares of 61 peatlands with 56.6 million cubic meters of peat were surveyed. The field work was carried out using survey line grids with study sites at the intervals of 100 meters. At each site the cover type, the peat type and the decomposition degree of peat as well as the portion of dead, undecomposed trees in the deposits were determined and recorded. Altogether 583 peat samples were taken to the laboratory for pH, water content and ash content determinations. Heating value was determined for 302 samples,sulphur content for 203 samples and behavior of the peat ash melting for 67. 640 hectares of 25 peatlands was good for fuel production. The quantity of usable peat is 12.4 cubic meters in situ. The energy content is 4.9 million MWh calculated as milled peat at 50% moisture content and 6.1 million MWh calculated as sod peat at 35% moisture content.

46263 **(GTK-TURVE—210) Mires and their peat resources in Vihanti. Part II.** Virtanen, K.; Herranen, T. (Geological Survey of Finland, Kuopio). 1988. 163p. (In Finnish). NTIS (US Sales Only), PC A08. Order Number DE88754074/JAW.

The Geological Survey of Finland has studied the area of 19346 hectares of mires in the municipality of Ruukki. Majority of the mires with industrial interest were included in the study. This work is a part of the total inventory of the peat resources of Finland. The detailed surveys were made using line grids, where study sites were staked out at 100 meter intervals. The cover type, the peat type, the decomposition degree of peat and the substratum of mires were determined at each study site. Laboratory samples were taken from selected sites to determine the pH value, ash content, heating value and bulk density of peat (507 samples). Samples were also analysed for some trace elements. (Co, Cr, Cu, Cd, Pb, Zn, Ni, Ag, Mn, Fe and S). Behavior of the peat ash melting and the cation exchange capasity were determined, too. The mires of Ruukki are both ombrotrophic bogs and minerotrophic fens. 58% of the peat deposits is composed of Carex and 42% of Sphagnum peat. In the fens there are chemical precipitates in the peat such as siderite and vivianite. The averege ash content is 4.0%, bulk density 101 kg/m"3 (in situ) and the heating value 21.2 MJ/kg. Slightly the trace-elememt contents of peat samples of Ruukki are small (E:G: average content of Cr 26 ppm, Cu 7 ppm, Ni 4 ppm, Pb 5 ppm, Zn 9 ppm, Cd 0.2 ppm, Fe 0.19% and S 0.23%). Most of the traces have become consentrated to the bottom layer of peat, but Pb and Zn to the surface layer. The melting point of slitghtly humified surface Sphagnum peat ashes are lower than those of other peat ash samples. The cation exchange capasity (CEC) is highest in slightly humified Acutifolia-type Sphagnum peat (max 128 m ekv/100g dry peat). Altogether 2927 ha of mires were evaluated suitable for peat production. The amount of useful peat is 40 mill. m"3 in situ and the amount of useful horticultural peat is 4 mill. m"3 in situ. The energy content of fuel peat is 21 MWh on dry basis.

46264 **(GTK-TURVE—212) Peat surveys in Pudasjaervi.** Haenninen, P. (Geological Survey of Finland, Kuopio). 1988. 138p. (In Finnish). NTIS (US Sales Only), PC A07/MF A01. Order Number DE88754075/JAW.

The Geological Survey of Finland made an iventory of the peat resources in the municipality of Pudasjaervi in 1896. 24 bogs covering a total area of 9750 hectares were surveyed. The field work was carried out using survey line grids with study sites at the intervals of 100 meters. At each site the cover type, the peat type and the decomposition degree of peat as well as the portion of dead, undecomposed trees in the deposits, were determined and recorded. Altogether 600 peat samples were taken to the laboratory for pH, water content, heating value and ash content determinations. Sulpher content was determined for 107 samples. 1780 hectares of peatland was good for peat production. The quantity of usable peat is 31.0 million cubic meters in situ. The energy content of usable peat is 55 million GJ or 15 million MWh on dry basis.

46265 **(GTK-TURVE—213) Peat resources of Kuusankoski and Kouvola.** Maekilae, M.; Grundstroem, A. (Geologian Tutkimuskeskus, Espoo (Finland)). 1988. 58p. (In Finnish). NTIS (US Sales Only), PC A04/MF A01. Order Number DE88754076/JAW.

Geological Survey of Finland investigated the quantity and quality of peatlands in the towns of Kuusankoski and Kouvola, southeasern Finland, during 1986. Altogether 997 hectares of peatland were studied. This area covers 6.7% of the land area. The total peatland area suitable for fuel peat production is 103 hectares. Useful peat resources are 1.48 million m"3 in situ. The energy content equals to 0.70 million MWh as calculated for 50% moisture content. The area suitable for horticultural peat production is 104 hectares, containing about 1.27 million m"3 of peat in situ. The average depht of peat deposits is 1.34 m, including 0.48 m of slightly humified surfical layer. The total amount of peat of the studied peatlands is 13.4 million m"3. Area deeper than 2 m contains 6.3 million m"3 or 47% of the total reserves including 3.7 million m"3 of better humified peat.32% of the peat layers are Sphagnum predominant, 66% of the peat is Carex predominant and rest of the peat is Bryales predominant. The average net calorific value of dry peat is 20.9 MJ/kg and 9.2 MJ/kg when calculated for 50% moisture content. The average dry bulk density of the samples is 84.3 kg/m"3 in situ, moisture content 91.3% of wet weight, pHvalue 4.6, ash content 3.0% and sulphure content 0.15% on dry basis. The part of Savonsuo (12) belongs to The National Mire Preservation Programme.

46266 **(GTK-TURVE—214) Peat resources of Haapajaervi.** Korpijaakko, M.; Koivisto, M. (Geological Survey of Finland, Kuopio). 1988. 53p. (In Finnish). NTIS (US Sales Only), PC A04/MF A01. Order Number DE88754077/JAW.

The Geological Survey of Finland investigated the quantity and quality of peatlands in Haapajaervi in 1983,1984 and 1986. Altogether 9695 hectares of peatland were studied. The total peatland area suitable for fuel peat production is 1724 hectares. Useful peat resources are 26.12 million m"3 in situ. Its dry matter content is 2505x10"3 tons and energy content is 51.96 mill. GJ (14.44 mill. MWh) on dry basis, at 50% moisture 46.81 mill. GJ (13.01 mill. MWh) and at 35% moisture 48.74 mill. GJ (13.55 mill. MWh). When adding the peatlands, which already had been taken into production by VAPO, to the estimated peat production area, which is suitable for peat production but not yet investigated, then the area of fuel peat production increases to 2700 hectares and the quantity of usable peat is 41 million cubic meters in situ. Its energy content is 81.08 mill. GJ (22.54 mill. MWh) on dry basis, at 50% moisture 74.02 mill. GJ (20.58 mill. MWh) and at 35% moisture 76.32 mill. GJ (21.22 mill. MWh).

46267 **(GTK-TURVE—215) Mires in the western part of Kankaanpaeae and the potential use of their peat recources.** Sten, C.-G.; Svahnbaeck, L. (Geological Survey of Finland, Kuopio). 1988. 95p. (In Finnish). NTIS (US Sales Only), PC A05/MF A01. Order Number DE88754078/JAW.

The Geological Survey of Finland has made peat investigations on the mires in the western part of the town Kankaanpaeae, western Finland in 1983-84. In all 18 mires covering a total of 1548 hectares were studied. Most of the mires are concentric raised bogs of the Satakunta-type with rather high peat hummocks often with an aboundance of lichens, water pools and bare-peat hollows are frequent. According to this investigation the most common site type is pine mires (76%). There are 19% of treeless mires, 3% of hardwood-spruce mires and 2% old peat land forests. Sixtyeight per cent of the peat is Sphangnum predominant, and 32% Carex predominant. The mires studied contain a total of 37.1 million m"3 of peat. The mean depth of the mires is 2.4 m including the slightly humitied surface layer, which averages 0.9 m in tickness. The mean humification degree (H) of the peat is 5.1 (v. Post's scale). As much as 81% of the total peat or 30.7 million m"3, is at a depht of over 2 m in an area covering 885 ha. The average asidity (pH) of the peat is 3.9, the average ash content is 1.5% of dry weight, the water content 92.2% of weight and the dry density 79 kg per m"3. The effective caloric value of the dry peat is 20.4 MJ/kg. The sulphure content is o.21% of dry weight. The total area of six peatlands suitable for fuel peat production is 357 hectares, in average 2.4 meters deep and the available amount of peat is 8. 70 million cubic meters. The energy content of fuel peat at 50% moinsture is 12.7 mill. GJ or 3.5 mill MWh. Horticultural peat is to be found in three peat bogs at 76 hectares with an average thickness of 1.3 m. The available amount of horticultural peat is 1 mill. m"3. The Sphagnum peat samples has an asidity of 3.6 and the ash content is 1.0% of dry weight. Kahilakeidas, a typical concentric raised bog of which 149 ha are in natural conditions, is included in the National Mire Preservation Programme.

0120 Mining

REFER ALSO TO CITATION(S) 46258

46268 **(ACIRL-PR—88-1) Joy flexible conveyor train demonstration at Box Flat Colliery.** O'Beirne, T.; Napper, A. (Australian Coal Industry Research Labs. Ltd., North Ryde). 1988. 50p. Australian Coal Industry Research Labs. Ltd., North Ryde.

Australia's first continuous and flexible face haulage system, the 100 m long Joy 2 Flexible Conveyor Train (FCT), has been in-

stalled and trialled. This Joy FCT has, successfully transported 198,334 tonnes of coal from both production drivage and partial pillar extraction. The machine has matched, or exceeded, all of its manufacturer's written specifications except the belt life-span. The only major problem during its use was the replacement of the complete belt at 75,629 tonnes due to internal delamination and the replacement of 2 sections at 173,569 tonnes to try a new batch. The fault appears to be a batch quality control problem. The FCT was installed in conjunction with a rebuilt Jeffrey 120H2 continuous miner and Joy 10SC6 shuttle car modified by the inclusion of a rotary pick breaker and a boom extension. The modified 10SC6 was used to control surges and limit product top size. It acted as a flexible buffer between the miner and the FCT bridge conveyor. In general, the FCT itself has demonstrated its maker's claims and the expectations of the colliery management. The rebuilt face equipment has not been as reliable. The cyclic nature of cutting, machine moves and bolting was definitely the limiting factor in the overall performance of the mining system. In the latter stages of the trial, the 10SC6 was removed totally with some adverse results. The shuttle car based feeder breaker cannot be considered an outstanding success, however, it was a good starting point.

46269 (SAND—88-1969C) Technology development for blasting based mining operations. Preece, D.S.; Thorne, B.J. (Sandia National Labs., Albuquerque, NM (USA)). 1988. Contract AC04-76DP00789. 11p. (CONF-880725—2). NTIS, PC A03/MF A01; 1; GPO Dep. Order Number DE88013367/JAW.

From Oil shale, tar sands and mild gasification; Morgantown, WV, USA (19 Jul 1988).

A key step in the utilization of either coal or oil shale is the initial mining. Most mining operations are either entirely or partially based on rock fragmentation using chemical explosives. Despite the importance of the blasting step in mining, there remains considerable uncertainty concerning the fundamental mechanisms controlling blast results. The lack of fundamental understanding limits the amount of optimization that can be done for blasting since trial and error must be used which often are cost prohibitive in large scale mining operations. Mining and material handling is one of the major capital and operating expenses associated with oil shale development. It is estimated that the contribution of mining and material handling to total costs will be on the order of 30%-40% for most oil shale operations. The sheer magnitude of the amount of material that must be processed for even a modest oil shale facility will require some of the largest mining operations in the world. Efficient blasting can have a significant impact on the overall economics of a mining operation as has been demonstrated in surface coal mining. The same will be true for oil shale operations whether they are based on surface or underground mining. Examples of areas where this program can impact oil shale mining include: optimizing round design as a function of face geometry, shale grade and explosive type, minimizing pillar damage through timing control and loading factor, adaptation of traditional blast and muck operations to hybrid mining schemes that might involve the use of continuous miners. 7 refs., 8 figs.

46270 (UCRL—21079) Shielding of electromagnetic waves by geological structure: Final report. Zhou, Q.; Becker, A. (Lawrence Livermore National Lab., CA (USA)). Mar 1987. Contract W-7405-ENG-48. 51p. NTIS, PC A04/MF A01; 1; GPO Dep. Order Number DE88014160/JAW.

We have studied the feasibility of through-the-earth communication and of the detection of a buried magnetic dipole transmitter. The source is assumed to be a vertical magnetic dipole transmitter embedded in a conductive half space while the magnetic field observations are made on the surface. A rectangular thin sheet conductor which is inserted into the half space, shields and distorts the received magnetic field. In the frequency domain, it is found that the induction number of the half space and the product of frequency and sheet conductance are the important parameters. In the time domain, however, it is the ratio of sheet conductance to the pulse width which is the dominant factor when the half space is resistive. When it is conductive, then the ratio of the product of the half space conductivity and source depth to the pulse width is the dominant factor. The position of the sheet conductor relative to the source is also important. When it is above the source a shielding effect is observed. On the other hand, when it is located below or alongside the source it may slightly enhance the response. 14 refs., 15 figs.

0130 Transport And Handling

REFER ALSO TO CITATION(S) 46300, 47180

46271 (CONF-880765—1) Pipe flow measurements of a transparent non-Newtonian slurry. Park, Joel T.; Mannheimer, Richard J.; Grimley, Terrence A.; Morrow, Thomas B. (Southwest Research Inst., San Antonio, TX (USA)). 1988. Contract FG22-86PC90962. 25p. NTIS, PC A03/MF A01; 1; GPO Dep. Order Number DE88015042/JAW.

From 4. international symposium on applications of laser anemometry to fluid mechanics; Lisbon, Portugal (11 Jul 1988).

An experimental description of the flow structure of non-Newtonian slurries in the laminar, transitional, and full turbulent pipe flow regimes is the primary objective of this research. Experiments were conducted in a large-scale pipe slurry flow facility with an inside pipe diameter of 51 mm. The transparent slurry formulated for these experiments exhibited a yield-power-law behavior from cup viscometer measurements. The velocity profile for laminar flow from laser Doppler velocimeter (LDV) measurements had a central plug flow region, and it was in agreement with theory. The range of the transition region was narrower than that for a Newtonian fluid. The mean velocity profile for turbulent flow was close to a 1/7 power-law velocity profile. The rms longitudinal velocity profile was also similar to a classical turbulent pipe flow experiment for a Newtonian fluid; however, the rms tangential velocity profile was significantly different. 11 refs., 9 figs., 1 tab.

46272 (DOE/PC/90518—T5) Aerated and vibrated chute feeders for particulate materials: Quarterly technical report for the period March 1, 1988 to May 31, 1988. Jackson, R. (Princeton Univ., NJ (USA). Dept. of Chemical Engineering). 1988. Contract FG22-86PC90518. 5p. NTIS, PC A02/MF A01; 1; GPO Dep. Order Number DE88012663/JAW.

As part of our efforts towards understanding the floe behavior of particulate materials and investigating efficient methods for their transportation, we have studied the problem of aerated chute flow. We have developed a theoretical model that describes the rheology of particulate materials and are in the process of building an apparatus that will help us make experimental observations of granular flow in aerated chutes. 11 refs., 2 figs., 2 tabs.

0140 Combustion

REFER ALSO TO CITATION(S) 46244, 46843, 47179

46273 (ANL/FE—88-3) Alkali metal vapor removal from a pressurized fluidized-bed combustor process stream: Annual report, October 1985-September 1986. Lee, S.H.D.; Myles, K.M. (Argonne National Lab., IL (USA)). Mar 1988. Contract W-31109-ENG-38. 52p. NTIS, PC A04. Order Number DE88013966/JAW.

A laboratory-scale pressurized fluidized-bed coal combustor (PFBC)/ alkali sorber was used (1) to measure the alkali vapor (Na and K) concentration in a PFBC process stream on a real-time on-line basis and (2) to demonstrate simultaneously the granular-bed sorber concept for the removal of alkali vapors from a hot PFBC process stream. An Ames alkali analyzer was used as an on-line, real-time monitor. A batch-type alkali and particulate sampling train (APST) was also installed as a backup for the analysis of both alkali vapor and particulate loading in the gas stream. Three test series of the PFBC/alkali sorber unit were run with Pittsburgh Sewickley coal and Tymochtee dolomite at an average bed temperature ranging from 900 to 925{degree}C and a system pressure of 9 atm absolute. In all three test series, NaCl vapor was injected into the sorber unit to provide about 580 ppbW in the PFBC process stream. In all three test series, the injected NaCl vapor was not detected by both the Ames alkali analyzer and the APST. It was significantly captured by the fly ash. The high-temperature stainless-

steel sampling line could also be a sink for the NaCl vapor. 24 refs., 21 figs., 14 tabs.

46274 (DOE/PC/79909—2) Pyrite thermochemistry, ash agglomeration, and char fragmentation during pulverized coal combustion: Quarterly report for the period December 15, 1987--March 15, 1988. Akan-Etuk, A.; Niksa, S.; Kruger, C.H. (Stanford Univ., CA (USA). High Temperature Gasdynamics Lab.). Apr 1988. Contract FG22-87PC79909. 31p. NTIS, PC A03. Order Number DE88013730/JAW.

We continued to define the design specifications for representative sampling of particulates in our one-dimensional coal flow reactor. The first element in the collection and analysis train, the extraction probe for solid samples, is now fully designed. Design drawings are enclosed with this report and contractors for fabrication are now being solicited. The probe consists of five concentric channels. Extracted solids and combustion gases are quenched with five radial jets of cold helium at the inlet to the central tube, and transported into the components for size analysis. The central tube is porus metal which transpires a radial stream to prevent aerosol deposition. The two adjacent channels deliver streams of cold helium to both the quench point and the transpiring wall. The outer two channels pass water to insulate the extracted fluid from the hot combustion gases. Based on a computer simulator for the momentum and heat transfer through the probe, thermal quenching is rapid enough to resolve the level of burnoff within an uncertainty of 2.5%. At the flowrates which meet the stipulations for isokinetic sampling, the pressure drop is minimal, so that the optical sizer can be operated at nominally atmospheric pressure. 4 figs., 2 tabs.

46275 (DOE/PC/79916—2) Determination of local radiative properties in coal-fired flames: Technical progress report, third quarter of the first year, March 15--June 15, 1988. Menguc, M.P.; Altenkirch, R.A. (Kentucky Univ., Lexington (USA). Dept. of Mechanical Engineering). [1988]. Contract FG22-87PC79916. 17p. NTIS, PC A03/MF A01; 1; GPO Dep. Order Number DE88015036/JAW.

Main interest in the project is to determine the radiative properties of coal particles in situ and establish a data bank for radiative properties of different coal types. During the last three months, we have continued setting up the experiment and have worked on analytical inverse solution techniques. Recently, experiments on the pulverized-coal-fired burner have been started. These experiments are mainly preliminary test runs, and because of this we do not present any data in this report. Instead, we only describe the burner and the fluidized-bed coal feeder. Meanwhile, we continue working on the analytical techniques for the solution of the inverse radiation problem. 4 refs., 6 figs.

46276 (DOE/PC/80529—T9) Effects of coal structure on pulverized coal combustion processes: Quarterly technical progress report No. 11 for the period 1 April 1988-30 June 1988. Wells, W.F.; Smoot, L.D. (Brigham Young Univ., Provo, UT (USA). Combustion Lab.). 15 Jul 1988. Contract FG22-85PC80529. 16p. NTIS, PC A03/MF A01; 1; GPO Dep. Order Number TI88013653/JAW.

Nitrogen BET and carbon dioxide DP surface area measurements were made for the extracted chars. Pore size distributions were measured for the Wyoming subbituminous and Utah bituminous virgin coals. The optical system for char oxidation tests was aligned and tested for focus. The heating system of the secondary gas was tested. The heating system uses an inductively coupled plasma flame to heat argon gas, which is them mixed with the secondary gas. A factor analysis program, SIGMA, was obtained for use in data analysis. 11 refs., 9 figs., 1 tab.

46277 (ENEA-RT-FARE—87-6) Fluidized bed combustion. De Simone, L.; Scialdoni, R. (ENEA, Rome (Italy)). Dec 1987. 52p. (In Italian). NTIS (US Sales Only), PC A04. Order Number DE88754229/JAW.

The utilization of coal as an energy source in Italy is now a necessary strategic choice; fluidized bed technology makes coal usage technically favourable and environmentally safe. The present paper is an examination of state-of-the-art, fluidized bed, combustion technologies, their reliability and possible applications.

46278 Development of a thermopile-based deposition sensor. Sun, Y.Z.; Kale, S.R.; Bajura, R.A.; Keech, T.W. Jr. (Beijing Graduate School of East China Petroleum Institute, 20 Xue Yuan Road, P.O. Box 902, Beijing (CN)). pp 23-28 of Developments in experimental techniques in heat transfer and combustion. Warrington, R.O. Jr.; Chen, M.M.; Felske, J.D.; Grosshandler, W.L. New York, NY; American Society of Mechanical Engineers (1987). (CONF-870816—).

From 24. national heat transfer conference and exhibition; Pittsburgh, PA, USA (9 Aug 1987).

The operation and reliability of novel utilization techniques, such as coal fired turbines, has been impeded by the formation of ash deposits on component surfaces (combustor walls and blades). Currently, no sensors are available to measure deposit growth especially under the severe conditions encountered in commercial combustors. A commercially available sensor consisting of a thermopile (group of thermocouples connected in series) encased in a ceramic filling was tested in a hot fly-ash laden air stream. Opposite faces of the device formed the hot and cold junctions of the thermopile, and these were exposed to the air stream and to the cooling water, respectively. This temperature difference generates an electrical potential difference which decreases with deposit growth because of the insulating properties of the ash build up. Tests were conducted at temperatures up to 260°C; mean air velocities of zero, 2.6 m/s and 5.1 m/s; constant ash loading in the air stream; and surface loading up to 33 mg/cm/sup 2/. The results indicated a linear response with the device sensitivity being constant at 0.39 mV/(mg/cm/sup 2/) over a large portion of the test conditions. This device can, therefore, be used to reliably measure ash deposition rates. However, for short periods, the deposit thickness cannot be accurately resolved beyond the measurement uncertainties.

0150 Marketing And Economics

46279 (DOE/EIA—0121(88/1Q)) Quarterly coal report, January-March 1988. (USDOE Energy Information Administration, Washington, DC. Office of Coal, Nuclear, Electric and Alternate Fuels). 3 Aug 1988. 145p. NTIS, PC A07/MF A01 - GPO; 1; GPO Dep. Order Number DE88015398/JAW.

During January through March 1988, new first-quarter records were established for both the production and consumption of coal. These levels continue a pattern begun in 1987 and are attributable, in large part, to lower generation from hydroelectric plants and higher coal consumption by electric utility plants. Coal production rose to 236.8 million short tons. This was the highest first quarter figure ever recorded. Wyoming, Montana, West Virginia, Kentucky, Virginia and New Mexico registered significant production gains versus the first quarter of 1987. Coal consumption also reached a record first-quarter level of 219.6 million short tons, with electric utilities accounting for 83.9% (16.9 million short tons) of the 20.1 million short ton increase over the first-quarter 1987 consumption total. The average price of coal received at electric utilities declined for the third consecutive quarter, reaching $31.12 per short ton, but coal prices paid by industrial consumers rose slightly from their fourth-quarter 1987 levels. First quarter coal exports were lower for the third straight year, reaching 16.1 million short tons. The average price of coal exports rose slightly to $42.09 per short ton from $41.39 per short ton in the previous quarter. Stockpiles at the nation's coal consuming plants were 173.7 million short tons. This level is only slightly higher than the first-quarter 1987 level. Coal stocks held by producers and distributors (36.8 million short tons) were also only slightly above their level at the end of the first quarter of 1987. 14 figs., 68 tabs.

46280 (DOE/EIA—0125(88/1Q)) Coal distribution, January-March 1988. (USDOE Energy Information Administration, Washington, DC. Office of Coal, Nuclear, Electric and Alternate Fuels). 8 Jul 1988. 89p. NTIS, PC A05/MF A01 - GPO; 1; GPO Dep. Order Number DE88013529/JAW.

For the US coal industry, both coal distribution and coal production were higher in the first quarter of 1988 than in January-March 1987. The quantity of coal distributed to domestic and foreign markets totaled 229.2 million short tons, 5.6 percent more than

in the corresponding period of 1987. Coal production of 236.8 million short tons was 6.8 percent greater than in the same period of 1987. Coal inventories increased to 36.8 million short tons on March 31, 1988, nearly 30 percent above their respective level on December 31, 1987. As is the custom in the first quarter of each year, some distributors accrue larger coal inventories for gradual depletion throughout the year. Nationally, stocks were about the same on March 31, 1988, as a year earlier. Other significant occurrences during January-March 1988 included: Domestic coal shipments to each consumer sector were higher than those a year earlier; Export coal shipments were higher than in the first quarter of 1987; and Coal production and shipments in the Western Region were significantly higher than in the first 3 months of 1987. 6 figs., 33 tabs.

0160 Health And Safety

REFER ALSO TO CITATION(S) 46254, 46258, 47375

46281 **(EUR—10872-FR) Community research into the relationship between epidemiological data and the toxicity of mine dusts.** Le Bouffant, L. (Commission of the European Communities, Luxembourg). 1987. 201p. (In French). Commission of the European Communities, Luxembourg.

Every coal-producing country in the ECSC has found differences in the incidence of pneumoconiosis between coalfields and even within the same coalfield. Assessment of the risk of pneumoconiosis is based on a whole series of factors. One particularly important requirement is to be able to assess the specific toxicity of a dust, which in itself may depend on a series of physical and chemical characteristics. In order to establish a valid correlation between these characteristics and toxicity it was considered necessary to have recourse both to reliable analytical methods and reliable biological tests. Institutes in the Federal Republic of Germany, Belgium, France and the United Kingdom were involved in this Community research. The aims were to compare the methods for testing toxicity and the results obtained to establish correlations between the composition of a dust and its toxicity and to ascertain which composition characteristics and toxicity tests could be related to epidemiological data. All the results obtained were subjected to statistical analysis. Although not all the problems have been solved, the results indicate the probable existence of a clear relationship between mineralogical and toxicological characteristics and epidemiological data.

46282 **(PB—85-220-556/A06) Causes of disability in employees of the mining industry: analysis of social security disability benefit awards and allowances to workers 1969-1973, 1975-1976.** Osborne, R.; Fischbach, T. (National Inst. for Occupational Safety and Health, Cincinnati, OH (USA). Div. of Surveillance, Hazard Evaluation and Field Studies). Apr 1985. 97p. (NIOSH—85-105). National Technical Information Service (NTIS), 5285 Port Royal Road, Springfield, VA 22161, USA.

This study examined the causes of disability for Social Security Administration disability benefit awards and allowances to white male miners for 1969-1973 and 1975-1976. Age adjusted proportional morbidity ratios (PMR's) were calculated for 67 causes of disability for six mining occupations and four mining industries. Significantly high PMR'S were found for diseases of the respiratory system as causes of disability among all groups except the oil and gas extraction industry. Musculoskeletal diseases caused disproportionately high disability among employees of the oil and gas extraction industry. PMR's were recalculated excluding diseases of the respiratory system since the very high association between these diseases and mining could obscure other associations. After removing disabilities from respiratory deseases from the data, the PMR's for accidents, poisonings, and violence and musculoskeletal disease were significantly high. These results agreed with those of previous morbidity and mortality studies and illustrate the utility of routinely collected disability data as a surveillance tool in occupational disease and injury epidemiology.

46283 **(PNL-SA—15217, pp 175-185) Effects of health and environmental research on the design of solvent-refined coal/two stage liquefaction process.** Kelly, C.M. (Air Products and Chemicals, Inc., Allentown, PA (USA)). 1987. NTIS, PC A99/MF A01. Order Number DE88007332/JAW. (CONF-851027—).

From 24. Hanford life sciences symposium and environmental research on complex organic mixtures; Richland, WA, USA (20 Oct 1985).

The Solvent Refined Coal/Two Stage Liquefaction (SRC/TSL) Demonstration Plant project, which closed in September 1984, included a comprehensive program of research on the health and environmental effects of coal-derived synthetic fuels; some of this research is ongoing. Results to date of this and other programs have provided a much better understanding of the relationship between processing conditions and biological activity. These studies not only confirmed that several materials associated with the SRC/TSL process are mutagenic, but also identified the classes of chemical compounds most strongly associated with the mutagenicity and their distribution among the products. Furthermore, research uncovered a number of unexpected biological effects that could pose health risks. Should the process be commercialized, several changes might be warranted, particularly in the product slate to be marketed. The demonstration project included a comprehensive program to protect the health and ensure the safety of plant workers as well as that of the general public. Research results have confirmed the importance of this program and identified modifications that might be considered for added protection.

46284 **(PNL-SA—15217, pp 187-194) Impact of health effects on the development of coal liquefaction/resid hydrocracking technology.** Greene, M.; Gupta, A. (Combustion Engineering Inc., Bloomfield, NJ (USA)). 1987. NTIS, PC A99/MF A01. Order Number DE88007332/JAW. (CONF-851027—). Contract AC22-82PC50021;AC22-84PC70042.

From 24. Hanford life sciences symposium and environmental research on complex organic mixtures; Richland, WA, USA (20 Oct 1985).

Lummus Crest Inc. (LCI) has been developing a new approach to the two-stage liquefaction of coal and upgrading of coal extracts. Technology development has been directed toward achieving coal syncrude products with no carcinogenicity and a propensity to produce high-quality jet/diesel fuel fractions upon catalytic hydroprocessing. Processing schemes and reaction conditions were formulated to achieve this product slate under conditions of high hydrogen efficiency. The LCI approach is to liquefy coal under short-contact-time conditions in the presence of a hydrogen donor-rich solvent produced in the second-stage LC-Finer/sup SM/ LCI's proprietary expanded-bed hydrocracking/hydrodesulfurization process. At proper operating severity, the LC-Finer/sup SM/ unit can generate an active recycle donor solvent under conditions of minimal hydrogen uptake. The 650°F+ materials can then be further cracked to 650°F- distillates in a downstream fixed-bed hydrocracker. The authors will review the evolution of the LCI coal-liquefaction process to produce environmentally acceptable coal syncrudes having higher value when processed in a petroleum refinery for the production of jet/diesel fuels and gasoline.

46285 **(PNL-SA—15217, pp 195-197) Impact of the coal-liquids health research program on the EDS process.** Vick, G.K. (Exxon Research and Engineering Company, Annandale, NJ (USA)). 1987. NTIS, PC A99/MF A01. Order Number DE88007332/JAW. (CONF-851027—).

From 24. Hanford life sciences symposium and environmental research on complex organic mixtures; Richland, WA, USA (20 Oct 1985).

This paper discusses the impact of the environmental/health database of direct coal liquefaction on development of the EDS coal-liquefaction process. In particular, the paper addresses significant findings in the area of toxicology that affect process development and design.

46286 (PNL-SA—15217, pp 199-210) **Comparative biology and chemistry of distillates from different coal-liquefaction processes.** Wright, C.W.; Later, D.W.; Chess, E.K.; Lucke, R.B.; Stewart, D.L.; Pelroy, R.A.; Mahlum, D.D.; Wilson, B.W. 1987. NTIS, PC A99/MF A01. Order Number DE88007332/JAW. (CONF-851027—).

From 24. Hanford life sciences symposium and environmental research on complex organic mixtures; Richland, WA, USA (20 Oct 1985).

Data on the chemical composition and toxicologic activity of narrow-boiling-range distillates from the noncatalytic solvent refined coal-I (SRC-I) and -II processes, and the catalytic H-Coal, EDS, and integrated two-stage liquefaction (ITSL) processes were compiled and compared. Materials from catalytic processes contained higher concentrations of alkylated and hydrogenated polycyclic aromatic hydrocarbons (PAH) and lower concentrations of nitrogen-containing polycyclic aromatic compounds (NPAC), including amino-substituted PAH, than noncatalytic processes. Hydrogen content decreased, and nitrogen, oxygen, and sulfur heteroatomic content of coal-liquefaction materials from both catalytic and noncatalytic processes increased with increasing distillation temperature. In addition, aliphatic hydrocarbon content decreased, while NPAC and hydroxy-substituted PAH content increased, with increasing distillation temperature for all the coal-liquefaction materials. Mutagenic activity was generally reduced in hydrotreated liquids as compared to single-stage products. Results of biological assays of 50°F distillate cuts from various coal liquids were similar; materials boiling above 700°F showed significant mutagenic and tumorgenic activity; activity generally increased with increasing distillation temperature.

46287 (PNL-SA—15217, pp 211-221) **Upgrading coal-derived liquids to reduce toxicity. I. Evaluation of nonhydrotreatment processes as alternatives or supplements to hydrotreatment.** Ho, C.H.; Jones, A.R.; Smith, L.H.; Epler, J.L.; Griest, W.H.; Guerin, M.R. (Oak Ridge National Lab., TN (USA)). 1987. NTIS, PC A99/MF A01. Order Number DE88007332/JAW. (CONF-851027—). Contract AC05-84OR21400.

From 24. Hanford life sciences symposium and environmental research on complex organic mixtures; Richland, WA, USA (20 Oct 1985).

Seven nonhydrotreatment processes related to petroleum refining practices were evaluated at laboratory scale as alternative to hydrotreatment in reducing toxicity of several coal-derived liquids. These treatments were distillation, acid or alkaline washing, pentane deasphalting, pentane-furfural partitioning, clay percolation, and oxidation. The treated products were subjected to microbial mutagenicity testing or mouse dermal tumorigenicity screening. Effects of treatment on dermal tumorigens (especially benzo[a]pyrene [BaP]) in some treated products were also determined. Results confirm that distillation is a desirable first step in upgrading coal-derived liquids. Only the vacuum gas oil (VGO) fraction (or distillates containing VGO-boiling-range material) showed significant mutagenicity and tumorigenicity. Acid treatment, pentane deasphalting, and pentane-furfural partitioning reduced mutagenicity, but were less effective in reducing tumorigenicity of an H-Coal VGO. Although alkaline treatment did not reduce mutagenicity, it might reduce the number of tumor-promoting agents. The effectiveness of sulfuric acid and sodium hydroxide washing as pretreatments to mitigate toxicity by catalytic hydrotreatment (over Pd/C or sulfided Shell 324 M nickel/molybdenum catalyst) was investigated by laboratory hydrogenation of H-Coal VGO. Sulfuric acid pretreatment, especially with Pd/C, enhanced the reduction of BaP. Sodium hydroxide pretreatment did not substantially enhance BaP reduction.

46288 (PNL-SA—15217, pp 293-305) **Improvements in the CHO/HGPRT assay and sample preparation for mutagenesis testing of complex.** Cunningham, M.L.; Swanson, M.S.; Reilly, C.A. Jr.; Haugen, D.A. (Argonne National Lab., IL (USA)). 1987. NTIS, PC A99/MF A01. Order Number DE88007332/JAW. (CONF-851027—). Contract W-31-109-ENG-38.

From 24. Hanford life sciences symposium and environmental research on complex organic mixtures; Richland, WA, USA (20 Oct 1985).

The authors modified sample preparation conditions for the standard Chinese hamster ovary hypoxanthine-guanine phosphoribosyl transferase (CHO/HGPRT) mutagenesis assay to enhance detection of mutagens in complex, chemical mixtures: (a) samples were extracted with NaOH to remove cytotoxic phenols which mask the effects of mutagenic compounds, (b) samples were fractionated chromatographically to isolate compound classes by aromatic carbon number, (c) low sample concentrations were used to give more linear dose-mutation relationships. They also demonstrated that the presence of calcium phosphate enhanced mutagenic activity. Cytotoxicity of 2- and 3- ring polycyclic aromatic hydrocarbons isolated from a coal-gasification tar was diminished by adding uridine diphosphoglucuronic acid or partially purified DT-diaphorase to the microsomal metabolic activation system. They demonstrated that, with appropriate modifications, the CHO/HGPRT assay can effectively measure the mutagenicity of complex mixtures.

46289 (PNL-SA—15217, pp 317-327) **Preneoplastic transformation or respiratory epithelial cells by complex organic mixtures in a clonal assay.** Mass, M.J.; Marr, C.M. III; Mumford, J.L. (Environmental Protection Agency, Research Triangle Park, NC (USA)). 1987. NTIS, PC A99/MF A01. Order Number DE88007332/JAW. (CONF-851027—).

From 24. Hanford life sciences symposium and environmental research on complex organic mixtures; Richland, WA, USA (20 Oct 1985).

Complex organic extracts of particulate emissions from three heating sources were assayed for the presence of agents that induce preneoplastic transformation of rat tracheal epithelial (RTE) cells in an in vitro clonal assay. Samples were from homes in Xuan Wei County, China, were incidences of lung cancer are 4-fold above the national average. This is believed to result from inhalation exposures to routine burning of smoky coal in an open indoor pit for heat and cooking under unvented conditions. Dichloromethane extracts of coal particulate samples from the air in homes burning this fuel were tested in an RTE cell transformation assay. Results were compared to those obtained from particulate emissions of two other fuels from Chinese communes with low lung-cancer incidences; those using smokeless coal, and wood. Samples were analyzed by gas chromatography/mass spectrometry for polycyclic aromatic hydrocarbon (PAH) content. Organic extracts of smoky coal emissions produced significant reproducible increases in the number of transformed RTE cells in vitro. Extracts of smokeless coal emissions and wood smoke produced variable, elevated transformation levels. The lack of reproducibility may result from the insoluble nature of these complex organic mixtures in culture medium. Chemical analyses of selected PAH in emissions from the two coals were similar, but different from those for wood smoke.

46290 (PNL-SA—15217, pp 343-356) **Model compounds selected for research on health effects of complex chemical mixtures.** Duhamel, A.P. (Department of Energy, Washington, DC (USA)). 1987. NTIS, PC A99/MF A01. Order Number DE88007332/JAW. (CONF-851027—).

From 24. Hanford life sciences symposium and environmental research on complex organic mixtures; Richland, WA, USA (20 Oct 1985).

The Department of Energy's Office of Health and Environmental Research is conducting a research program on the health effects of complex organic mixtures. Oils and tars and their various chemical and/or physical fractions are being evaluated in research on synthetic fuels. Studies on pure compounds were recently included to address mechanistic and dose-response issues. This paper summarizes the rationale used to select appropriate chemicals and lists them. Selection criteria included: a) toxicological significance, b) potential for human exposures, and c) presence in energy-related complex mixtures. Polycyclic aromatic compounds of chemical classes thought to be important contributors to the bacterial mutagenicity and/or mouse-skin carcinogenicity of fossil fuel mixtures as dominate the initial selections.

46291 (PNL-SA—15217, pp 357-368) **Binding of chemicals to mouse lung DNA after pretreatment with single chemicals and complex chemical mixtures.** Mitchell, C.E.; Howard, A.J.; Dutcher, J.S.; Henderson, T.R.; McClellan, R.O. (Lovelace Inhalation Toxicology Research Institute, Albuquerque, NM (USA)). 1987. NTIS, PC A99/MF A01. Order Number DE88007332/JAW. (CONF-851027—). Contract AC04-76EV01013.

From 24. Hanford life sciences symposium and environmental research on complex organic mixtures; Richland, WA, USA (20 Oct 1985).

The effects of pre-exposure to coal gas condensate (CGC), diesel exhaust extract (DEE), or selected compounds in complex chemical mixtures were investigated on the binding of chemicals to mouse lung DNA. The amount of radiolabel bound to DNA after intratracheal administration of labeled benzo[a]pyrene (BaP), 2-aminoanthracene (2-AA), phenanthridone, (PNDO), 1-nitropyrene (NP), dinitropyrenes, (DNP), or 1,3,6-trinitropyrene (TNP) was determined after pretreatment with CGC, DEE, BaP, or NP. The BaP and CGC were the most effective inducing agents. Four hours after administration of radiolabels in BaP-induced mice, amounts of [^{14}C]-1-NP, [^{14}C]DNP, [^{3}H]BaP, and [^{3}H]-2-AA bound to DNA were increased 160-, 7.6-, 5.4-, and 5.2-fold above control values. Pretreatment with CGC increased binding of [^{14}C]-1-NP, [^{3}H]BaP, and [^{3}H]2-AA, 90-, 7.6-, and 2.8-fold, respectively, above control values. The amount of 1-NP bound to DNA was 30 times greater than BaP. Following induction, the average amount of label bound 1 wk after administration ranged from 43 to 62% of 4-hr-bound activity. The [^{14}C]PNDO did not bind to DNA under the assay conditions used. The DEE pretreatment increased binding of BaP but had little effect on binding of other chemicals. The 1-NP pretreatment did not increase binding of any chemicals.

46292 (PNL-SA—15217, pp 369-378) **Metabolism and DNA-binding of BAP in the presence of complex organic mixtures.** Springer, D.L.; Dankovic, D.A.; Thomas, B.L.; Hopkins, K.L.; Bean, R.M.; Mahlum, D.D. 1987. NTIS, PC A99/MF A01. Order Number DE88007332/JAW. (CONF-851027—).

From 24. Hanford life sciences symposium and environmental research on complex organic mixtures; Richland, WA, USA (20 Oct 1985).

Previous studies showed that the mutagenic, carcinogenic and DNA-binding activities of benzo[z]pyrene (BaP) decreased when BaP was coadministered with complex organic mixtures. To identify components of the mixture that were responsible for this effect, a high-boiling coal liquid was separated into aliphatic, polycyclic aromatic hydrocarbon (PAH), nitrogen-containing polycyclic aromatic compounds (NPAC) and oxygen-containing PAH fractions (HPAH); these were spiked with ^{3}H-BaP and administered dermally to mice, and DNA was isolated 24 hr later. The BaP binding, estimated by radioactivity associated with DNA, decreased to 47, 55 and 66% of that for the same BaP dose administered alone for PAH, NPAC and HPAH fractions, respectively. In vitro studies with Aroclor-induced rat liver S9 showed that the rate of BaP metabolism decreased when BaP was coadministered with the mixtures. However, BaP metabolite profiles for BaP alone and in the presence of the mixture were similar. Differences in mutagenic and, presumably, carcinogenic activities of BaP administered with a complex mixture may reflect decreased rates of BaP conversion to reactive metabolites.

46293 (PNL-SA—15217, pp 379-386) **Toxicological interactions between carcinogenic and weakly carcinogenic mixtures in the mouse-skin initiation-promotion system.** Haugen, D.A.; Swanson, M.S.; Kirchner, F.R.; Stamoudis, V.C.; Reilly, C.A. Jr. (Argonne National Lab., IL (USA)). 1987. NTIS, PC A99/MF A01. Order Number DE88007332/JAW. (CONF-851027—). Contract W-31-109-ENG-38.

From 24. Hanford life sciences symposium and environmental research on complex organic mixtures; Richland, WA, USA (20 Oct 1985).

The authors previously observed that carcinogenic activity of the neutral fraction of a coal gasifier tar was greater in the absence of other tar components. Other investigators showed that dermal tumor-initiating activity of benzo[a]pyrene (BaP) and binding of BaP to mouse skin DNA decreased when BaP was administered in the presence of coal liquids. Therefore, they used silica column chromatography to separate the neutral fraction of the coal gasification tar into polar and nonpolar subfractions. The subfractions were assayed, individually and recombined, for dermal tumor-initiating activity in SKH-hairless mice with promotion by twice-weekly treatment with 12-0-tetradecanoylphorbol-13-acetate for 26 wk. Animals were observed for an additional 10 wk. Most tumor-initiating activity was associated with the nonpolar fraction enriched in polycyclic aromatic hydrocarbons. The weakly tumorigenic polar neutral subfraction decreased the tumor-initiating activity of the PAH-enriched fraction at one dose level, but not another.

46294 (PNL-SA—15217, pp 395-408) **Toxicological effects of EDS liquids.** McKee, R.H.; Biles, R.W. (Exxon Corporation, East Millstone, NJ (USA)). 1987. NTIS, PC A99/MF A01. Order Number DE88007332/JAW. (CONF-851027—).

From 24. Hanford life sciences symposium and environmental research on complex organic mixtures; Richland, WA, USA (20 Oct 1985).

The EDS Toxicology Program evaluated potential human health or environmental effects associated with process commercialization. Test samples included five process streams that represented the greatest potential hazards in an operating facility. Effects of single and repeated exposures were characterized, and developmental toxicity and mutagenic and carcinogenic potential of each stream were assessed. Process streams with high phenolic content were acutely toxic. High-boiling-range liquids were carcinogenic and mutagenic and impeded fetal development in utero. The similarity in response of EDS liquids to other coal liquids and coal tars suggests that potential hazards can be mitigated using engineering controls and industrial hygiene guidelines designed to minimize exposure to phenolics and high-boiling polycyclic aromatic compounds.

46295 (PNL-SA—15217, pp 409-420) **Effects of complex organic mixtures of coal liquid on cardiovascular function in the rat.** Sasser, L.B.; Zangar, R.C.; Springer, D.L.; Mahlum, D.D. 1987. NTIS, PC A99/MF A01. Order Number DE88007332/JAW. (CONF-851027—).

From 24. Hanford life sciences symposium and environmental research on complex organic mixtures; Richland, WA, USA (20 Oct 1985).

The authors evaluated the effects of high-boiling coal liquids on the rat cardiovascular system. In two studies, rats were exposed to coal-derived heavy distillate (HD), via inhalation, for 6 hr per day, 5 days per wk for 6 wk. The HD produced high blood pressure, without affecting electrocardiogram patterns, in rats exposed to air concentrations of 0.7 mg/L and 0.24 mg/L. After 6 wk recovery, blood pressure was not statistically different among groups. They also observed significant changes in other cardiovascular measurements, including increases in plasma volume, blood volume, blood PCO_2, plasma cholesterol and high-density lipoprotein, and decreases in plasma angiotensin levels. In a third study, blood pressures of rats exposed to HD were evaluated after dermal application, but not after gavage.

46296 (PNL-SA—15217, pp 443-456) **Toxicity of solvent-refined coal-I/two stage liquefaction (SRC-I/TSL) products, intermediate streams, and waste materials in short-term tests.** Drozdowicz, B.Z.; Kelly, C.M. (Air Products and Chemicals, Inc., Allentown, PA (USA)). 1987. NTIS, PC A99/MF A01. Order Number DE88007332/JAW. (CONF-851027—).

From 24. Hanford life sciences symposium and environmental research on complex organic mixtures; Richland, WA, USA (20 Oct 1985).

The Solvent-Refined Coal-I/Two-Stage Liquefaction (SRC-I/TSL) Demonstration Project, phased out in September 1984, included a comprehensive research program on health and environmental effects of coal-derived fuels. Tests completed to date include whole-animal acute toxicity and in vitro mutagenicity assays of various SRC-I/TSL products, intermediate streams, and wastes. Several whole-animal carcinogenicity assays are still in progress. In vitro mutagenicity assays showed that SRC-I/TSL waste materials that

might enter the environment were nonmutagenic, but as expected, some liquid products showed mutagenicity, which was related to boiling point, similar to other coal liquids. Unexpectedly, aqueous suspensions of solid SRC-I/TSL products were also mutagenic. Most products and intermediate streams had low acute toxicity, but some materials, especially low- and medium-boiling-range liquids, were skin and eye irritants, possibly reflecting their high phenolic content. Test results indicate the need to protect workers from exposure to many SRC-I/TSL materials, including some thought to be of little hazard. If the SRC-I/TSL process is demonstrated on a commercial scale, health-protection plans will have to be modified, especially to minimize emissions of SRC-I/TSL dust.

46297 (PNL-SA—15217, pp 657-666) **Relationship between solubility and toxicity of coal-liquefaction materials to the freshwater crustacean Daphnia magna.** Dauble, D.D.; Gray, R.H.; Scott, A.J.; Thomas, B.L. 1987. NTIS, PC A99/MF A01. Order Number DE88007332/JAW. (CONF-851027—).

From 24. Hanford life sciences symposium and environmental research on complex organic mixtures; Richland, WA, USA (20 Oct 1985).

Potential ecological risk of coal-derived liquids that may be released to freshwater ecosystems is dependent on the concentration of water-soluble compounds in the parent material and of the toxic properties of constituent compounds. Highly water-soluble components that remain bioavailable and are present in water at acutely toxic concentrations pose a problem for many aquatic organisms. The authors screened coal liquids derived from several process design options to evaluate the acute toxicity of their water-soluble fractions (WSF) to Daphnia magna. Solubility of coal-derived materials varied and WSF ranged from 44 to 2260 mg/L total carbon (TC). The most water-soluble materials exhibited greater toxicity, based on percent dilution to the WSF. However, toxicity of all materials was similar when based on soluble components (TC) in solution. Phenols comprised the majority of TC in solution. Because toxicity based on total phenols was generally greater than that for individual phenolics tested separately, other water-soluble chemical classes in these complex organic likely contribute to observed toxicity.

46298 (PNL-SA—15217, pp 683-693) **Equilibrium distribution of components in the vapor space of a solvent refined coal-I liquid storage tank.** Kelly, C.M.; Buiocchi, E.K. (Villanova Univ., PA (USA)). 1987. NTIS, PC A99/MF A01. Order Number DE88007332/JAW. (CONF-851027—).

From 24. Hanford life sciences symposium and environmental research on complex organic mixtures; Richland, WA, USA (20 Oct 1985).

In a simple experiment the authors simulated the distribution of compounds between the liquid and the head space when Solvent-Refined Coal (SRC)-I middle distillate is stored in tanks, both at ambient and elevated temperatures. Gas chromatographic analyses showed that vapor compositions corresponded to the lowest-boiling cut of the liquids. Because the lowest-boiling-point cut of the liquids has been shown to have a much lower mutagenic potency than the whole liquid, it appears that basing health risk estimates for the vapor on the mutagenicity of the whole liquid is unnecessarily conservative. Health risk estimates for the vapor should be based on the mutagenic potency of the lowest-boiling fraction of the liquid.

46299 (PNL-SA—15217, pp 737-746) **Health risks from coal-liquefaction atmospheric discharges.** Mellinger, P.J. (737-746). 1987. NTIS, PC A99/MF A01. Order Number DE88007332/JAW. (CONF-851027—).

From 24. Hanford life sciences symposium and environmental research on complex organic mixtures; Richland, WA, USA (20 Oct 1985).

The authors estimated the potential for human health effects from inhalation of nonmethane hydrocarbons (NMHC) released from a hypothetical direct coal-liquefaction industry producing about 600,000 bbl/day of fuel. General assumptions are refined in a tiered sequence, using available environmental, chemical, and epidemiological data. Surrogate health-effects data considered for use in estimating potential effects from a coal-liquefaction industry included those for coke-oven and British gas retort emissions, roofing tar and asphalts, and cigarette smoke. The chemical and physical nature of coke-oven emissions was judged to more closely approximate potential coal-liquefaction emissions than those from the other industries. In addition, extensive epidemiological data for coke-oven workers provided a basis for estimating health effects from toxicological studies on coal-liquefaction NMHC.

0170 Legislation And Regulations

46300 **Facilitating the national distribution and utilization of coal. Introduced in the Senate, One Hundredth Congress, Second Session, April 28, 1988.** Washington, DC; Government Printing Office (1988). 44p.

The purpose of the bill (S. 801) as reported by the Committee on Energy and Natural Resources, is to facilitate the development of interstate coal-pipeline distribution systems, subject to the primacy of State water law. This is accomplished by granting the Federal power of eminent domain to those interstate coal-pipeline distribution systems that are determined by the Secretary of Energy to be in the national interest based on certain statutory findings, while ensuring, through the delegation of Congressional power under the Commerce Clause, primacy of State law and procedure regarding water used in interstate coal-pipeline distribution systems. In addition, the measure as reported by the Committee modifies section 2(c) of the Mineral Leasing Act to permit railroads or their affiliated coal-mining companies to obtain Federal coal leases. Railroads or their affiliates wishing to lease Federal coal within the railroad's land grant area must meet certain specified conditions.

02 PETROLEUM

0202 Geology And Exploration

46301 **Light collection in scintillation detector composites for neutron detection.** Knoll, G.F.; Knoll, T.F.; Henderson, T.M. (The Univ. of Michigan (US)). *IEEE (Institute of Electrical and Electronics Engineers) Transactions on Nuclear Science;* **35**: No. 1, 872-875(Feb 1988). (CONF-871006—).

From 34. nuclear science symposium and 19. nuclear power systems symposium; San Francisco, CA, USA (21 Oct 1987).

With the goal of developing neutron detectors of high detection efficiency and fast response, the authors have been investigating the heterogeneous combination of neutron-conversion materials in a plastic or liquid scintillation matrix. One such combination consists of thin-wall glass microspheres filled with high pressure /sup 3/He gas dispersed in plastic scintillator. The authors have now developed glass formulations that are capable of containing the helium in shells with wall thickness as low as 1 μm with leak rates at room temperature that correspond to several years half life. The energy loss of the reaction products in the shell wall and the low light yield of plastic scintillators for low energy protons result in low light yield per event. With the use of a newly-developed optical modeling code, they are also investigating the incorporation of wavelength shifting elements to aid in the collection of this light from highly scattering composite scintillation media.

46302 **High temperature electronics application in well logging.** Traeger, R.K.; Lysne, P.C. (Dept. 6240, Sandia National Labs., P.O. Box 5800, Albuquerque, NM (US)). *IEEE (Institute of Electrical and Electronics Engineers) Transactions on Nuclear Science;* **35**: No. 1, 852-854(Feb 1988). (CONF-871006—).

From 34. nuclear science symposium and 19. nuclear power systems symposium; San Francisco, CA, USA (21 Oct 1987).

Commercial systems used in well logging are available for routine use at temperatures to 160°C and other hostile environment systems have advertised capabilities to 260°C. However, scientific wells, deep gas wells, geothermal wells and boreholes used for the diagnostics of in situ processes such as fire and steam floods can have borehole temperatures up to 500°C which eliminate the use of existing logging tools or borehole diagnostic systems. In the late 1970's and early 1980's a significant effort was mounted by the DOE/Geothermal Technology Division to develop and commercialize high temperature logging systems. In the early 1980's, proto-

type components were available that could be used in logging tools for use at 250-300°C. However, in the 1980's the need for such high temperature systems was insufficient for suppliers to routinely provide these components. Looking at future high temperature logging applications, the authors recognize that electronics are only one part of a logging system, and all aspects and hardware must be compatible with high temperature use. Therefore, an overall system design must consider: 1. the market needed to assure supply of specialty components; 2. measurement needs in terms of time, temperature and environment; 3. the effect of temperature on the formation being interrogated; and 4. that electronics, interconnections, cables, cable heads, sensors and housings are all system components which individually or interconnected may be the source of the temperature limit. Some of these items are reviewed in this paper in terms of tools used for neutron logging.

46303 **Nuclear modeling techniques and nuclear data.** Soran, P.D. (Univ. of California, Lawrence Livermore National Lab., Livermore, CA (US)). *IEEE (Institute of Electrical and Electronics Engineers) Transactions on Nuclear Science;* 35: No. 1, 847-851(Feb 1988). (CONF-871006—).

From 34. nuclear science symposium and 19. nuclear power systems symposium; San Francisco, CA, USA (21 Oct 1987).

The current state-of-particle transport computer codes and associated nuclear data bases permit the accurate simulation of downhole sensor packages. Mathematical modeling can minimize design and experiment time, as well as provide new information on sensor design, environmental effects, and interpretation questions. Monte Carlo techniques can provide energy, time, and spatial information to permit signal partitioning and sensitivity analysis in complex geometries and environments.

46304 **Analytical models of slug tests.** Karasaki, K.; Long, J.C.S.; Witherspoon, P.A. (Lawrence Berkeley Lab., CA (USA)). *Water Resources Research;* 24: No. 1, 115-126(Jan 1988). Contract AC03-76SF00098.

In the present paper, attempts are made to develop solutions to various models of slug tests that may be applicable in analyzing the results of such tests where existing solutions are inadequate. Various geometries that may be encountered in heterogeneous systems such as fractured rocks are considered. Solutions are presented for linear flow, radial flow with boundaries, two layer, and concentric composite models with different flow geometries between the inner and outer region. Solutions are obtained in Laplace space and inverted back to real space numerically. Type curves are presented for each solution. Analyses of the type curves and derivative response curves reveal that many curves have unique shapes only for certain combination of the flow parameters and the distance. Other sets of type curves are similar in shape, although log-log plots and derivative plots may emphasize some features that may not be apparent in semilog plots. These results show that slug tests suffer problems of nonuniqueness to a greater extent than other well tests.

0203 Drilling And Production

46305 **(DOE/BC/14230—T1) Project on enhanced recovery and the states analysis of unrecovered mobile oil and enhanced oil recovery in Texas: Progress report.** (Interstate Oil Compact Commission, Oklahoma City, OK (USA)). 6 Jun 1988. Contract FG19-88BC14230. 7p. NTIS, PC A02. Order Number DE88012956/JAW.

The ongoing effort is designed to identify and evaluate realistic state economic incentives to encourage oil recovery. The current focus of the project involves evaluation of potential recovery in Texas from both enhanced oil recovery (EOR), to recover residual oil, and infill drilling to improve primary and secondary production of unrecovered mobile oil (UMO). The expansion of the analysis in Texas to consider the potential production of UMO, with and without tax incentives, is an important enhancement not only to this study, but also to the Tertiary Oil Recovery Information System (TORIS) in general. Data gathering activities and modeling requirements have been identified and planned. The Bureau of Economic Geology (BEG) at the University of Texas at Austin is providing the state support for the project. BEG has initiated a major data gathering and enhancement effort. The addition of geological information on reservoirs contained in TORIS is critical to the infill drilling analysis. In addition, data on depositional systems will significantly enhance the abilities of TORIS in estimating the recovery potential for EOR. BEG has undertaken a substantial effort to describe Texas reservoirs by both lithology and environment of deposition. The major differences in recovery potential are caused by varying degrees and types of reservoir heterogeneity in unique depositional systems. The heterogeneity which impacts recovery efficiency is being qualitatively described in the updated data base. Improved understanding and analysis of heterogeneity are critical to increasing future recovery either by infill drilling, modified waterflooding, or enhanced oil recovery. The diversity of the oil resource in Texas, described by play and environment of deposition, demonstrates the importance of geological information in evaluating recovery potential. 4 figs.

0206 Health And Safety

REFER ALSO TO CITATION(S) 46290, 46291

46306 (PNL-SA—15217, pp 259-269) **Potential interactions between different chemical fractions from diesel-exhaust extracts in the production of mutations.** Brooks, A.L.; Seizinger, D.E. (Lovelace Inhalation Toxicology Research Institute, Albuquerque, NM (USA)). 1987. NTIS, PC A99/MF A01. Order Number DE88007332/JAW. (CONF-851027—). Contract AC04-76EV01013.

From 24. Hanford life sciences symposium and environmental research on complex organic mixtures; Richland, WA, USA (20 Oct 1985).

Diesel-exhaust particulates were collected from five light-duty cars operated on a reference diesel fuel or from a single car operated on five different fuels. Particle-associated organic material was extracted with methylene chloride. Each extract was fractionated by liquid-solid chromatography (LSC), followed by high-performance liquid chromatography, to separate crude diesel-exhaust particle extracts into nine chemical classes. The crude extract and each fraction from each operating condition were tested for mutagenic potency in the Ames/Salmonella assay (strain TA98), with or without rat liver microsomal fraction S9. Selected fractions were tested alone and in combination to determine if the mutagenic activity from combined fractions equaled the predicted mutagenic activity, assuming activity was additive. The most mutagenic fraction, containing nitropolycyclic aromatic hydrocarbons (PAH), was combined with two nonmutagenic fractions. The mutagenic activity of two polar fractions was also tested, alone and in combination. There were no significant differences in mutagenic activity between crude and reconstructed samples. Thus, fractionation procedures used to separate diesel-exhaust extracts had no effect on the mutagenic activity of the complex mixture. Nor did removal of any fraction alter the ability of other fractions to express their direct mutagenic activity in Salmonella.

46307 (PNL-SA—15217, pp 421-432) **Effects of 4-week inhalation exposure of rats to oil shale dust and diesel exhaust.** Mauderly, J.L.; Bice, D.E.; Carpenter, R.L.; Hanson, R.L.; Henderson, R.F.; Jones, R.K.; McClellan, R.O.; Wolff, R.K. (Lovelace Inhalation Toxicology Research Institute, Albuquerque, NM (USA)). 1987. NTIS, PC A99/MF A01. Order Number DE88007332/JAW. (CONF-851027—).

From 24. Hanford life sciences symposium and environmental research on complex organic mixtures; Richland, WA, USA (20 Oct 1985).

Health effects of short-term inhalation exposures to raw (RS) and spent (SS) oil shale dusts, alone and in combination with diesel exhaust (D), were evaluated. F344 rats were exposed 7 hr/day, 5 days/wk to RS or SS at 10 mg/m^3, alone and in combination with D at 3.5 mg/m^3 soot (RSD, SSD), to D alone, and to clean air as controls (C) for 20 days. Effects were evaluated at the end of exposure and at 2 wk, 5 mo and 11 mo thereafter. Assays included respiratory function, pulmonary immune responses clearance of radiolabeled particles, enzymology and cytology in airway fluids, lung burdens of shale and diesel particles, and histopathology. Lung burdens of 590 to 2030 μg particulate/g lung were present at the end

of exposure, and 10 to 21% of this amount remained after 11 mo recover. There were no significant differences in accumulation or clearance of particles from the various materials. Body and lung weights, respiratory function and clearance of radiolabeled particles were unaffected. Mild inflammatory, cytotoxic and oxidant protective responses were detected, at the end of exposure, by analysis of airway fluids and histopathology. The decreasing order of response was: SSD > RSD > D > SS > RS. Little evidence of inflammation was observed in airway fluids at 2 wk or, by histopathology, at 5 mo after exposure. Pulmonary immune responses to instilled antigen were increased by SS at the end of exposure, but not thereafter. No chronic, progressive lung disease was observed 11 mo after exposure.

0207 Marketing And Economics

REFER ALSO TO CITATION(S) 46312, 46693

46308 (DOE/EIA—0035(88/04)) Monthly energy review, April 1988. (USDOE Energy Information Administration, Washington, DC. Office of Energy Markets and End Use). 26 Jul 1988. 133p. NTIS, PC A07/MF A01 - GPO; 1; GPO Dep. Order Number DE88014882/JAW.

The United States produced 3.0% more energy during the first 4 months of 1988 than during the same period in 1987, and US consumption was up 6.6%. Net imports of all energy were 18.0% higher, with net imports of petroleum up 17.4%, compared with levels during the first 4 months of 1987. Energy production during April 1988 totaled 5.4 quadrillion Btu, a 2.9-percent increase compared with the level of production during April 1987. Coal production was up 8.2%, natural gas production increased 1.3%, while petroleum production decreased 2.3%. All other forms of energy production combined were up 6.6% from the level of production during April 1987. Energy consumption during April 1988 totaled 6.3 quadrillion Btu, 3.5% above the level of consumption during April 1987. Natural gas consumption increased 9.4%, coal consumption rose 5.2%, while petroleum consumption decreased 0.5%. Consumption of all other forms of energy combined increased 3.7% compared with the level 1 year earlier. Net imports of energy during April 1988 totaled 1.0 quadrillion Btu, 20.1% above the level of net imports 1 year earlier. Net imports of natural gas increased 35.3%, while net imports of petroleum increased 26.6%. Net exports of coal increased 47.1% compared with the level in April 1987.

46309 (DOE/EIA—0109(88/05)) Petroleum supply monthly, May 1988. (USDOE Energy Information Administration, Washington, DC. Office of Oil and Gas). 25 Jul 1988. 113p. NTIS, PC A06/MF A01 - GPO; 1; GPO Dep. Order Number DE88014879/JAW.

Total US demand (measured as product supplied) for petroleum products in May 1988 averaged 16.1 million barrels per day. This is over 0.3 million barrels per day below April's average, but is still 0.1 million barrels per day above the May 1987 level. For the most part the disposition of the major products adhered to observed seasonal trends. Other May highlights include: total product stocks increased 32.5 million barrels, from 673.5 at the end of April to 706.0 million barrels at the end of May, and refinery utilization jumped to 85.8 percent. 6 refs.

46310 (UCLDE-DP—87-30) Long term international oil price. Pelin, E.R. (University Coll., London (UK). Dept. of Economics). 1987. 47p. British Library, Document Supply Centre, Boston Spa, Wetherby, West Yorks. LS23 7BQ.

This report attempts to derive the long term international oil price by evaluating the marginal production costs of the nearest substitutes. Two technical aspects are considered in detail: the existence of a suitable oil substitute and the availability of its production technologies. Two economic aspects are than considered: the marginal production cost and the theoretical framework explaining the exhaustible resource's price behaviour in the long run. It is concluded that US $47 per barrel will be the limit.

0209 Environmental Aspects

REFER ALSO TO CITATION(S) 46312

0230 Properties

REFER ALSO TO CITATION(S) 47035

46311 (PNL-SA—15217, pp 63-74) Comparative chemical characterization of shale oil- and petroleum-derived diesel fuels. Griest, W.H.; Higgins, C.E.; Guerin, M.R. (Oak Ridge National Lab., TN (USA)). 1987. NTIS, PC A99/MF A01. Order Number DE88007332/JAW. (CONF-851027—).

From 24. Hanford life sciences symposium and environmental research on complex organic mixtures; Richland, WA, USA (20 Oct 1985).

The Department of Defense is concerned with determining if a change over from petroleum- to shale oil-derived fuels would be accompanied by a significantly different toxicological hazard. To address this issue, the authors are conducting a toxicological comparison of diesel fuels derived from shale oil and from petroleum. Dermal and inhalation toxicology are current primary concerns. This paper presents the current results of comparative chemical analyses of the fuels. High-resolution gas chromatography analysis of the bulk fuels and their headspace vapor quantifies major components and generates fingerprints for relative compositional comparison. All fuels share the same set of major components, consisting of C_9 through C_{21} n-paraffins at levels of 1 to 29 mg/g each. In addition, branched hydrocarbons, and di- and triaromatic hydrocarbons are visualized. The inhalable vapors from the fuels consist mainly of C_2 to C_{10} hydrocarbons. Consistent differences between shale oil- and petroleum-derived diesel fuels as groups have been observed for minor components in both the fuels and their inhalable vapors. In addition, individual fuels within each group can be distinguished. Separate measurements of benzene and C_1 to C_4 alkyl benzenes show similar levels in the two sets of fuels. Benzo[a]pyrene levels in two shale-oil-derived diesel fuels fall within the range observed for petroleum-derived diesel fuels, but the highest concentration was found in a darkly colored, petroleum-derived DF-2.

0240 Storage

46312 (GAO/RCED—88-39) Superfund: Insuring underground petroleum tanks. (Office of the Comptroller General, Washington, DC (USA)). 1988. 70p. US General Accounting Office, P.O. Box 6015, Gaithersburg, MD 20877.

The Environmental Protection Agency has estimated that hundreds of thousands of underground petroleum tanks in the United States have corroded and leaked causing groundwater contamination, fires, or explosions. The price tag for the growing problem could range in the billions. EPA published proposed regulations requiring all tank owners and operators to maintain evidence of financial responsibility of which insurance is a primary method. However, tank insurance is limited because many insurers remain unwilling to enter this market. Expectation is that risks associated with tanks will decrease and the insurance situation will improve. But until that time, unless methods other than insurance become more available, circumstances warrant changes in EPA's timetable for implementing proposed regulations covering (1) financial responsibility requirements and (2) tank upgrading and replacement.

46313 (SAND—88-1309) Analysis of surface subsidence of the Strategic Petroleum Reserve crude oil storage sites from December 1982 to January 1988. Goin, K.L.; Neal, J.T. (Sandia National Labs., Albuquerque, NM (USA)). Jun 1988. Contract AC04-76DP00789. 39p. NTIS, PC A03/MF A01; 1; GPO Dep. Order Number DE88014192/JAW.

Surface elevation surveys have been made at Strategic Petroleum Reserve oil storage sites at approximate one-year intervals beginning in 1982. The surveys have indicated significant surface subsidence rates at all sites, with maximum values varying from about {minus}0.06 ft/yr at the Bryan Mound site to {minus}0.03 ft/yr at the West Hackberry site. Thirty-year projections of the indi-

cated subsidence rates suggest that surface subsidence could lead to surface flooding problems at the West Hackberry site and to a lesser degree at the Bayou Choctaw site. No such flooding problems are foreseen for the other three sites. However, subsidence rates at the Weeks Island site up to {minus}0.19 ft/yr are large enough to cause concern regarding possible salt fractures in the vicinity of shafts, which could in turn lead to water incursion into the mine. 9 refs., 5 figs., 2 tabs.

03 NATURAL GAS

0302 Geology And Exploration

REFER ALSO TO CITATION(S) 46301, 46302, 46303

0304 Products And By-products

REFER ALSO TO CITATION(S) 46760

0306 Marketing And Economics

46314 **(DOE/EIA—0130(88/05)) Natural gas monthly, May 1988.** (USDOE Energy Information Administration, Washington, DC. Office of Oil and Gas). 28 Jul 1988. 138p. NTIS, PC A07/MF A01 - GPO; 1; GPO Dep. Order Number DE88014875/JAW.

Gross withdrawals of natural gas (wet, after lease separation) from gas and oil wells in the United States during May 1988, were estimated at 1632 billion cubic feet, 1.3 percent above withdrawals during May 1987. Of the total quantity, an estimated 179 billion cubic feet were returned to gas and oil reservoirs for repressuring, pressure maintenance, and cycling; 10 billion cubic feet were vented or flared; and 33 billion cubic feet of nonhydrocarbon gases were removed. The remaining wet marketed production totaled 1410 billion cubic feet. Dry gas production (wet marketed production minus 67 billion cubic feet of extraction loss) totaled an estimated 1343 billion cubic feet, 1.7 percent above the May 1987 level. The total dry gas supply available for disposition in May 1988 was estimated at 1490 billion cubic feet, including 35 billion cubic feet withdrawn from storage, 11 billion cubic feet of supplemental supplies, and 101 billion cubic feet that were imported. In May 1987, dry gas available for disposition totaled 1419 billion cubic feet. Of the total dry gas supply available for disposition in May 1988, an estimated 1259 billion cubic feet were consumed, 294 billion cubic feet were injected into underground storage reservoirs, and 5 billion cubic feet were exported, leaving 68 billion cubic feet unaccounted for.

0310 Legislation And Regulation

46315 **Natural gas product valuation - NTL-5. Hearing before the Subcommittee on Mineral Resources Development and Production of the Committee on Energy and Natural Resources, United States Senate, One Hundredth Congress, First Session, July 10, 1987.** Washington, DC; Government Printing Office (1988). 270p.

NTL-5 simply means Notice to Lessees-5, which are regulations, and they relate to how you determine the value of natural gas production from Federal and Indian onshore leases. And in determining how you arrive at value, then the percentages for royalty for the owners is applied. NTL-5 was originally issued in 1977 and required a substantial amount of gas to be valued for royalty purposes at the Federal Energy Regulatory Commission ceiling price. At the start this 1980 were down. But as the market price fell, that didn't mean that the FERC ceiling price came down. Unfortunately, since those regulations were issued in 1977, there hasn't been any adjustment. The incongruities in this issue are the focus of this hearing, as the committee ponders changes in regulations, or perhaps additional legislation, to alleviate the problem. Seven witnesses testified, including officials of the Department of the Interior; Ute Indian Tribe; Chandler & Associates, Denver, CO; Rocky Mountain Oil & Gas Ass'n.; Shoshone Business Council, Fort Washaki, WY; and Independent Petroleum Ass'n. of Mountain States.

0320 Transport, Pipelines, And Handling

46316 **(PB—88-208822/XAB) Numerical modeling of flow through orifice meters. Topical report, July 1986-August 1987.** Sheikholeslami, M.Z.; Patel, B.R. (Creare, Inc., Hanover, NH (USA)). Mar 1988. 53p. (CREARE-TM—1160). NTIS, PC A04/MF A01.

Numerical modeling is performed for turbulent flow through orifice meters using Creare's computer program FLUENT. FLUENT solves the time averaged Navier-Stokes equations in 2D/3D Cartesian or cylindrical coordinates. Turbulence is simulated using a two-equation k-epsilon or algebraic stress-turbulence model. It is shown that an 80x60 grid distribution is sufficient to resolve the flow field around the orifice. The variations in discharge coefficient are studied as a result of variation in beta ratio, Reynolds number, upstream and downstream boundary conditions, pipe surface roughness, and upstream swirl. The effects of beta ratio and Reynolds number on the discharge coefficient are shown to be similar to the experimental data. It is also shown that the surface roughness can increase the discharge coefficient by about 0.7% for the range of roughness heights encountered in practice. The numerical-modeling approach would be most effective if it is combined with a systematic experimental program that can supply the necessary boundary conditions. It is recommended that numerical modeling be used for the study of other flow meters.

0340 Combustion

REFER ALSO TO CITATION(S) 46760

0350 Storage

46317 **(BNL—40632) Development of polymer concrete for dike insulation at LNG [liquified natural gas] facilities: Phase 3, Final report, November 1, 1986-August 31, 1987.** Fontana, J.J.; Reams, W.; Elling, D. (Gas Research Inst., Chicago, IL (USA); Brookhaven National Lab., Upton, NY (USA)). 31 Oct 1987. Contract AC02-76CH00016. 24p. (GRI—87-0301). NTIS, PC A03/MF A01; 1; GPO Dep. Order Number DE88014119/JAW.

Insulating polymer concrete (IPC) composites have been developed for use as a dike insulation material at Liquefied Natural Gas (LNG) storage facilities. Using inert, low density multicellular glass and/or ceramic macrospheres with unsaturated polyester or epoxy resins, a lightweight insulating polymer concrete has been made. Installation of IPC as an overlay on a concrete substrate has been shown to be a practical method of insulating LNG storage tank containment dikes. In many cases, the impounding dikes have compacted earthen or crushed stone surfaces. In these cases, the cost and time required to install a concrete substrate could be eliminated if the IPC can be installed by spraying or shotcretting it directly on the earthen or crushed stone surfaces. An evaluation was made of shotcretting IPC directly onto earthen and crushed stone surfaces using a polymer shotcrete machine. Shotcrete installations were made on sloped and vertical surfaces. In all cases, machine application was made without technical difficulty. Polymer shotcrete technology was shown to be technically feasible for IPC applications to a variety of substrates and surface geometries. Cost estimates indicate that IPC shotcrete applications can be almost 30% less than the installation of a concrete substrate with an IPC overlay.

04 OIL SHALES AND TAR SANDS

0404 Oil Production, Recovery, And Refining

46318 **Uniform retorting of a high void-contrast shale bed.** Bickel, T.C.; Engler, B.P.; Shirey, D.L. (Advanced Technology Div., Sandia National Labs., Albuquerque, NM (US)). pp 77-88 of The twentieth oil shale symposium proceedings. Gary, J.H. Golden, CO; Colorado School of Mines Press (1987). (CONF-8704104—).

From 20. oil shale symposium; Golden, CO, USA (21 Apr 1987).

Past in-situ shale retorts were typically designed with the aim that the fracturing event produce a rubble bed having uniform cross-sectional rubble properties. Real-time and postburn analyses of these processes have shown their Fischer Assay yields to be about 50%, or about 25% lower than expected based upon one-dimensional modeling studies. To increase oil yield, future in situ retorts need to achieve a uniform retorting front velocity within the rubble bed. While uniform rubble properties would realize this goal, edge effects created during rubbling make this difficult (perhaps impossible) to attain. An alternate approach is to adjust the rubble bed properties over the retort cross section (accounting for any rubbling effects or retort geometry) to achieve a uniform retorting front velocity. This paper describes a laboratory experiment (L-48) in which a highly instrumented, 100 kg bed of shale was retorted with zones of differing particle size and void fraction normal to the direction of flow. Shale particle size and void were varied over the retort cross section so that the retorting front would move at a constant velocity downward through the rubble bed. The authors used the Blake-Kozeny flow equation with effective particle diameters calculated using the Fair-Hatch mixture rule for distributed particle sizes and measured particle sphericities to accurately predict retorting front velocities over a wide range of void fractions.

0405 Properties And Composition

REFER ALSO TO CITATION(S) 46311, 46318, 46323

46319 (DOE/MC/11076—2460) Detection and identification of heteroatom-containing compounds in fossil fuel liquids by multinuclear NMR [nuclear magnetic resonance] spectroscopy: Part 1, Nitrogen-15. Netzel, D.A.; Coover, P.T. (Western Research Inst., Laramie, WY (USA)). Feb 1988. Contract FC21-86MC11076. 20p. NTIS, PC A03/MF A01; 1; GPO Dep. Order Number DE88011566/JAW.

Of the nuclear magnetic resonance (NMR) techniques available for the investigation of heteronuclear compounds in fossil fuel materials, only the polarization transfer techniques, INEPT and DEPT, and the multiple quantum coherence technique appear to be suitable for low-level detection of nitrogen-15 in nitrogen concentrates of a shale oil. Preliminary experiments were performed using the INEPT and the refocused INEPT pulse sequences. These pulse sequences were first evaluated based upon the carbon-13 NMR spectra of pyridine and later based upon the nitrogen-15 NMR spectra of a standard mixture of nitrogen compounds. Experiments indicated that the conventional INEPT pulse sequence gave a better signal-to-noise ratio than the refocused INEPT pulse sequence. From the nitogen-15 INEPT NMR spectra of the standard mixture, the limit of detection for nitrogen-15 in solution was determined for different nitrogen type compounds. The nitrogen-15 NMR INEPT spectra of a shale oil nitrogen concentrate resulted in noisy spectra but with several resonances detectable above the noise level. These resonances were in the region associated with amide and pyrrole-like nitrogen functionalities. The amide nitrogen was confirmed by amide carbon and hydrogen chemical shift data determined from the carbon-13 and hydrogen-1 NMR spectra, respectively. 5 refs., 5 figs., 2 tabs.

0407 Health And Safety

REFER ALSO TO CITATION(S) 46290, 46307

46320 (PNL-SA—15217, pp 307-315) In vivo induction of micronuclei and sister chromatid exchange by oil-shale retort waters. Kitchin, R.M.; Curry, P.T.; Levin, S.D. (Univ. of Wyoming, Laramie (USA)). 1987. NTIS, PC A99/MF A01. Order Number DE88007332/JAW. (CONF-851027—).

From 24. Hanford life sciences symposium and environmental research on complex organic mixtures; Richland, WA, USA (20 Oct 1985).

Three oil-shale retort waters, Paraho-500, Omega-9, and Geokinetics-17, were tested for mutagenicity, using in vivo sister chromatid exchange (SCE) and micronucleus assays. Effects of duration (chronic versus acute) and route (orally versus intraperitoneal injection) of exposure on sensitivity of these genotoxicological assays were assessed. One group of 2-mo-old inbred Swiss albino mice received a single injection of 0.1%, 1%, 10% or 100% concentration of Paraho-500, Omega-9 or Geokinetics-17 retort waters. Mice were sacrificed after 30 hr, and their bone marrow cells were analyzed for micronuclei. Another group was given the same concentration of retort water orally ad libitum over 30 days. Peripheral red blood cells, obtained from these animals every 10 days, were analyzed for micronuclei; bone marrow cells were analyzed for SCE after the 30 days exposure. Both Paraho-500 and Omega-9 significantly increased SCE frequency and were thus considered potentially mutagenic. Geokinetics-17 had no significant effect on SCE induction. Paraho-500 and Geokinetics-17 significantly increased the incidence of micronucleated polychromatic erythrocytes, but the effect occurred only after acute exposures. Thus, process waters from above ground and truly in situ oil shale retorts were clastogenic and potentially mutagenic in mice.

46321 (PNL-SA—15217, pp 329-341) DNA Analysis of epithelial cell suspensions. Wilson, J.S.; Johnson, N.F.; Holland, L.M. (Los Alamos National Lab, NM (USA)). 1987. NTIS, PC A99/MF A01. Order Number DE88007332/JAW. (CONF-851027—). Contract W-7405-ENG-36.

From 24. Hanford life sciences symposium and environmental research on complex organic mixtures; Richland, WA, USA (20 Oct 1985).

The authors investigated the short-term effects of shale oils on skin and ozone on tracheal epithelium. DNA analysis of cell suspensions labeled with mithramycin determined the percentages of cells in the G_1, S and G_2M Phases of the cell cycle. Differences from control animals occurred as early as 7 days after treatment and persisted 21 days thereafter. There was histological evidence of erythema and hyperplasia in shale-oil-exposed skins. The flow cytometric analysis of DNA content in shale-oil-exposed skin cells showed an increased (but not significant) percentage of cycling cells (28 to 31%) compared to those of controls (16%), and a significant increases compared to a standard petroleum-exposed group; there was also evidence of aneuploidy. Similar data from a positive control group showed increased percentages of cycling cells but no aneuploidy. Differing responses to various complex mixtures were also seen in long-term skin exposures. They also developed a technique to disperse the epithelial lining of the trachea and applied similar analytical techniques to tracheal cell suspensions from ozone-exposed rats. The DNA measurements of mithramycin-stained, fixed cells failed to demonstrate induction of cell proliferation. However, suspension of Hoechst-stained viable cells showed increased percentages of cycling cells, a finding supported by histological examination of sections of ozone-exposed tracheas. This technique allows early identification of cellular responses in two major organ systems following acute, in vivo exposures to various compounds.

46322 (PNL-SA—15217, pp 433-442) Lung free cell response and blood compartment studies following intrapulmonary deposition of oil shale. Wilson, J.S.; Saunders, G.C.; Holland, L.M.; Lehnert, B.E. (Los Alamos National Lab., NM (USA)). 1987. NTIS, PC A99/MF A01. Order Number DE88007332/JAW. (CONF-851027—).

From 24. Hanford life sciences symposium and environmental research on complex organic mixtures; Richland, WA, USA (20 Oct 1985).

Adult Syrian hamsters were intratracheally instilled with 10 mg particulate silica, raw shale, spent shale, or carrier vehicle (normal saline). For 4 to 63 days thereafter, lung free cell populations were obtained from the animals by bronchoalveolar lavage, and lavaged cell numbers and types were determined. Whole-blood samples were also obtained for leukocyte counts and differential analyses. Deposition of silica resulted in an early and persistent increase (~ 10-fold) in lung free cell population size. While most the increase reflected recruitment of polymorphonucleated leukocytes, the size of the alveolar macrophage population increased ~ 4-fold as early as day 4 after deposition. Although raw and spent shale particles caused alterations in cellular composition of free cell populations that were qualitatively similar to those produced by silica,

the magnitude of response was substantially less. Effects of particulate spent shale on the lung's free cell population were generally less pronounced and of shorter duration than those of raw shale. Changes in free cell populations in response to silica or to oil shales were not reflected in the white blood cell population. Leukocyte counts and percentages of monocytes, lymphocytes, neutrophils, and eosinophils in animals from different experimental groups were essentially identical to control values over the course of study.

0409 Waste Research And Management

46323 (DOE/MC/11076—2459) Validation of inorganic chemical speciation for geochemical models. (Western Research Inst., Laramie, WY (USA)). Nov 1987. Contract FC21-86MC11076. 30p. NTIS, PC A03/MF A01; 1; GPO Dep. Order Number DE88011565/JAW.

This report reviews general approaches for determining the chemical species of ionic materials and outlines a feasible approach to the analytical speciation of Cr(III) and (VI), and Fe(II) and (III) in an aqueous solution. The results of the speciation are related to existing models through redox electrode potential measurements. An ion chromatographic technique based on the separation of anionic species was selected for the speciation. Nonspecific (conductivity) and specific (electronic absorption spectrometry) detection alternatives are discussed, and detection limits are projected into the low parts per billion range. The results of the present work suggest a technique for the quantitative characterization of certain elemental species in an aqueous phase. The significance of the results with respect to geochemical meodeling will depend upon the application of the methodology in a variety of geochemical environments. 57 refs., 5 figs., 2 tabs.

05 NUCLEAR FUELS

0501 Reserves, Exploration, And Mining

46324 (INIS-BR—1190) Study of the chemical composition of waters in Morro do Ferro (MG), Brazil: transport of thorium and several tracer elements in solution. Pivetta, F.R. (Pontificia Univ. Catolica do Rio de Janeiro (Brazil). Dept. de Quimica). 1983. 92p. (In Portuguese). NTIS (US Sales Only), PC A05/MF A01. Order Number DE88703883/JAW.

The chemical composition of surface and well waters in the Morro do Ferro (Pocos de Caldas-MG.) Brazil, because the transport in solution may represent one important way of environmental contamination is studied. Samples of one stream in the base of the hill, of perfuration wells and of one galery were analysed in the period from 1980 (October) to 1982 (May). The contents of Mn, Fe, SiO/sub 2/, SO/sup 2-//sub 4/, PO/sup 3-//sub 4/, NO/sup -//sub 3/ and CO/sub 2/ is analysed in situ. (M.J.C.).

46325 Domestic uranium mining industry and the Department of Energy's Uranium Enrichment Program. Hearings before the Subcommittee on Energy Research and Development of the Committee on Energy and Natural Resources, United States Senate, One Hundredth Congress, First Session, March 9, and 13, 1987. Washington, DC; Government Printing Office (1988). 709p.

The hearing of March 9 concentrated on the issues of uranium mining, our dependence now and in the future on imported uranium ore, the importance to our national security of a viable domestic uranium industry, and the cost of cleaning up the uranium mill-tailings piles at existing uranium mill sites. In addition to brief statements by Sens. Domenici, Bingaman and J. Bennett Johnson, testimony was provided by two officials of the Dept. of Energy and officials of the American Nuclear Energy Council, the Oil, Chemical, and Atomic Workers International Union, Edison Electric Institute, and Uranium Producers of America. Using the background information provided by the hearing of March 9, the hearing of March 13, health with the enormous problems of the present DOE Uranium Enrichment Program. In addition to testimonies from officials from some of the organizations above, key testimonies were provided by D. David Rossin, Ass't. Secretary for Nuclear Energy, DOE; John Longnecker, Deputy Ass't. Secretary for Uranium Enrichment, DOE; and Edward S. Christenbury, general counsel, Tennessee Valley Authority. Appendixes include responses to additional committee questions from each hearing and additional material submitted for the record.

0504 Feed Processing

46326 Comparison of processes for conversion of $UO_2(NO_3)_2$ into UO_2. Haas, P.A. (Oak Ridge National Lab., TN (USA)). *Transactions of the American Nuclear Society;* 55: 140-142(1987). (CONF-8711195—).

From American Nuclear Society winter meeting; Los Angeles, CA, USA (15 Nov 1987).

Nuclear fuel cycles require conversion processes in which the product from preparation of purified uranium materials is converted into the feed for the fabrication of the reactor fuel. The preferred processes for conversion of uranyl nitrate solutions into UO_2 for fabrication of nuclear fuel pellets all involve thermal decomposition of a solid into UO_3 without melting. The criteria for comparisons of eight conversion processes apply to the preparation of UO_2 suitable for pressing into fuel pellets starting with pure uranyl nitrate solutions of moderate concentrations. The conversion processes that appear most promising have striking similarities. A solid uranium compound is formed and then is thermally decomposed to UO_3 without melting. Important characteristics of the UO_3 and the subsequently formed UO_2 are derived from those of the solid that is decomposed. This relationship is not possible for a simple thermal denitration in which molten uranyl nitrate decomposes to UO_3. The reduction of the UO_3 to UO_2 and stabilization of the UO_2 are similar for all processes. The common characteristics of these conversion processes simplify the comparisons. The major differences will be in the solids preparation steps before the final thermal decomposition and in the waste treatments required. Process characteristics are listed and the similarities are indicated by a generalized flow sheet.

0505 Uranium Enrichment

REFER ALSO TO CITATION(S) 46325, 46364, 46448, 46872

46327 Uranium enrichment program. Hearing before the Subcommittee on Energy and Power of the Committee on Energy and Commerce, House of Representatives, One Hundredth Congress, First Session, April 8, 1987. Washington, DC; Government Printing Office (1988). 277p.

The Atomic Energy Act is clear that the program must recover its costs over a reasonable period of time, yet there is currently an unrecovered in FY 1987, the program will spend over $1 billion in operating expenses to produce 4.2 million separative work units, or SWU's, and that means that, not including capital costs, the enrichment enterprise is producing SWU's at the cost of $250 per SWU while selling the SWU at $90 to $120. A pat of this loss is due to DOE's payment of over $500 million per year to TVA for capacity charges for electricity that is not taken. A budget resolution on the House floor recommends a requirement that domestic utilities buy from DOE to ensure that the program can recover its costs from its beneficiaries. Both TVA and DOE officials testified on the enigma of DOE having to purchase so much excess power, among other things. Witnesses also included officials from Uranium Producers of America, US General Accounting Office, National Taxpayers Union, American Enrichment Co., Inc., and Centerior Energy Corp.

46328 NEPA compliance for the SIS project. Cooper, S.C.; Gertz, C.P.; Trego, A.L. *Transactions of the American Nuclear Society;* 55: 84-85(1987). (CONF-8711195—).

From American Nuclear Society winter meeting; Los Angeles, CA, USA (15 Nov 1987).

The US Dept. of Energy (DOE) proposed the construction and operation of the Special Isotope Separation (SIS) Project, which is based on the Atomic Vapor Laser Isotope Separation process developed by the Lawrence Livermore National Laboratory. This process uses precisely tuned laser light to selectively ionize

a vapor stream of feed material. The undesired isotopes are ionized and collected on a charged extractor plate; the remaining nonionized vapor stream, enriched in the desired isotopes, is deposited on an uncharged collector element. In the proposed SIS project, undesirable isotopes of plutonium will be separated from ^{239}Pu to convert DOE-owned fuel-grade plutonium to weapons grade. The SIS project is a $535 million construction project with a peak labor force of 400 construction workers. Operations will require 750 people, including support personnel. The preparation of an Environmental Impact Statement (EIS) for the project is necessary for compliance with the National Environmental Policy Act for major federal actions. This is the first EIS to be required for a new project at the Idaho National Engineering Laboratory. The preparation of the EIS will assist in the decision process to construct and operate the SIS production plant and, if it is to be constructed, to determine its location. This paper describes the steps taken to comply with this act.

0507 Fuels Production And Properties

REFER ALSO TO CITATION(S) 46767, 46769, 46910, 47048, 47625, 47627, 47628, 47636, 47639

0508 Spent Fuels Reprocessing

REFER ALSO TO CITATION(S) 46364, 46377, 46412, 46441, 46652, 46653, 47037

46329 (NUCLEBRAS-CDTN—563) Chemical analysis used in nuclear fuels reprocessing of uranium and thorium. Schvartzman, M.M.A.M. (Centro de Desenvolvimento da Tecnologia Nuclear, Belo Horizonte (Brazil)). 1986. 182p. (In Portuguese). NTIS (US Sales Only), PC A09/MF A01. Order Number DE88703800/JAW.

An overall review of the analytical chemistry in nuclear fuel reprocessing is done. In Purex and Thorex process flowaheets, the analyses required to the control of the process, balance and accountability of fissile and fertile materials, and final product specification are pointed out. Some analytical methods applied to the determination of uranium, plutonium, thorium, nitric acid, tributylphosphate and fission products are described. Specific features of the analytical laboratories are presented. The radioactivity level of the samples requires facilities as shielded cells and glove boxes, and handling by remote control. Finally an application is reported of one analytical method to evaluate thorium content in organic and aqueous solutions, in cold tests of Thorex process. These tests were performed at CDTN/NUCLEBRAS.

46330 Plutonium recycle in French PWR plants. Rome, M.; Francillon, G.; le Bars, M. (EdF, Villeurbanne (France)). *Transactions of the American Nuclear Society;* **55**: 116-117(1987). (CONF-8711195—).

From American Nuclear Society winter meeting; Los Angeles, CA, USA (15 Nov 1987).

A significant amount of plutonium from presurized water reactor (PWR) spent fuel reprocessing will be available in France as soon as 1990. Due to the breeder program delay, this amount will be sufficient to permit plutonium recycle in a large number of French PWR plants. According to the French spent fuel reprocessing policy, plutonium recycling approaches two concerns: (1) economic compensation of the spent fuel reprocessing cost (difference between natural uranium and isotopic separation savings and plutonium fuel fabrication overcost); and (2) temporary solution for plutonium storage during the intermediate period before a demonstration of breeder program economy. Plutonium recycle in French PWR plants was decided in June 1985. This paper describes (a) scale of plutonium availability, (b) economic reasons for plutonium recycle, (c) feasibility studies, and (d) the French program.

46331 Coexisting ion effects on $UO_2$2i fluorescence in fuel reprocessing solutions. Matsui, T.; Fujimori, H.; Suzuki, K. *Transactions of the American Nuclear Society;* **55**: 142-143(1987). (CONF-8711195—).

From American Nuclear Society winter meeting; Los Angeles, CA, USA (15 Nov 1987).

Fluorometry has a possible use for on-line uranium concentration monitoring in raffinate of the codecontamination process in fuel reprocessing plants, since it has an intrinsically high sensitivity and a capability for remote monitoring using fiber optics. The raffinate are typically 2.5 to 3.5 mol/dm^3 of nitric acid solution, including 10 to 100 mg/dm^3 of uranium and almost 7 g/dm^3 of coexisting ions. The latter ions include ~ 30 species and are fission products, actinides, and corrosion products. Since UO_2^{2+} fluorescence is considered to be influenced by the coexisting species, the effects were studied using a simulated solution of the raffinate in the present report. The calculated results for UO_2^{2+} fluorescence are shown. Comparison of the calculated results with the experimental values indicates that reduction by the absorption of the excitation beam and the fluorescence is ~ 90% and the rest is by quenching. Therefore, uranium concentration can be measured within an accuracy of approximately +/- 10% only by the correction for the reduction of fluorescence by absorption, which can be easily realized by measuring absorbance of the sample solution.

0509 Transport And Storage

REFER ALSO TO CITATION(S) 46376, 46438, 46446, 47370

46332 (CEGB-TPRD/B—1021/R88) Behaviour of defected AGR fuel pins during water storage. Smith, C.A.; Clay, B.D.; Reed, D. (Central Electricity Generating Board, Berkeley (UK). Berkeley Nuclear Labs.). Sep 1987. 45p. NTIS (US Sales Only), PC A03/MF A01. Order Number DE88754277/JAW.

Results are presented of measurements made on the release of radioactivity to simulated Board AGR pond water from irradiated CAGR fuel pins, which have suspected genuine or artificially induced clad defects. Six fuel pins have been examined, one having the top end cap removed, two having suspected end cap defects and three with a 1 mm hole pierced through the clad; two of these three latter pins were only partially immersed and had the end cap in the gas space removed. The work completes the first phase of a series of experiments carried out at AEE Winfrith to gain an understanding of the behaviour of defective AGR fuel pins during aqueous storage. Data are given on the release fractions found for Cs-137, Sr-90, Ru-106, Sb-125 and Ce-144. Analytical data from earlier experiments which have recently become available are also presented. (U.K.).

0520 Waste Management

REFER ALSO TO CITATION(S) 46444, 46445, 46449, 46658, 46997, 47125, 47128, 47146, 47150, 47318, 47420, 47430

46333 (AERE-G—4421) Study of the behaviour of inorganic ion exchangers in the treatment of medium active effluents. Pt. 5. The encapsulation of inorganic ion exchangers in cement. Beaven, G.W.; Cross, J.E.; Hooper, E.W. (UKAEA Harwell Lab. Chemistry Div.). Apr 1988. 17p. NTIS (US Sales Only), PC A03/MF A01. Order Number DE88754261/JAW.

This report describes some results obtained for a generic programme of work for the Department of the Environment on the potential application of inorganic ion exchangers for the treatment of medium active effluents. The results from a preliminary investigation of the encapsulation of six ion exchangers (hydrous titanium oxide, hydrous manganese oxide, titanium and zirconium phosphates, polyantimonic acid and copper hexacyanoferrate(II) (CuFC)) in cement are reported. Compressive strength tests showed the presence of the exchangers reduced the strength of the cement but in all cases 33.3 wt% loadings of the exchangers resulted in homogeneous waste forms with adequate strength (≧ 4.5 MN m/sup -2/) for transport/storage. The results from a series of leach tests investigating the rate of release of caesium from cement samples containing caesium-loaded CuFC, are also reported. It was found that the presence of CuFC reduces the cumulative fraction of caesium leached but not the overall leach rate.

46334 (BMI/OCRD—30) MASCOT user's guide--Version 2.0: Analytical solutions for multidimensional transport of a four-member radionuclide decay chain in ground water. Gureghian, A.B. (Battelle Memorial Inst., Columbus, OH (USA). Office of Crystalline Repository Development). Jul 1988. Contract AC02-83CH10139. 64p. NTIS, PC A04/MF A01; 1; GPO Dep. Order Number DE88013651/JAW.

The MASCOT code computes the two- and three-dimensional space-time dependent convective-dispersive transport of a four-member radionuclide decay chain in unbounded homogeneous porous media, for constant and radionuclide-dependent release, and assuming steady- state isothermal ground-water flow and parallel streamlines. The model can handle a single or multiple finite line source or a Gaussian distributed source in the two-dimensional case, and a single or multiple patch source or bivariate-normal distributed source in the three-dimensional case. The differential equations are solved by Laplace and Fourier transforms and a Gauss-Legendre integration scheme. 33 figs., 3 tabs.

46335 (BMI/ONWI/C—12) Davis Canyon noise analysis: Revision 2. (Battelle Memorial Inst., Columbus, OH (USA). Office of Nuclear Waste Isolation; Bechtel National, Inc., San Francisco, CA (USA)). Nov 1985. Contract AC02-83CH10140;AC02-87CH10290. 705p. (BMI/ONWI—691). H. Order Number DE88013740/JAW.

A study was performed as part of the Civilian Radioactive Waste Management Program to quantify the level and effect of noise from the various major phases of development of the proposed potentially acceptable nuclear waste repository site at Davis Canyon, Utah. This report contains the results of a predictive noise level study for the site characterization, repository construction, and repository operational phases. Included herein are graphic representations of energy averaged sound levels, and of audibility levels representing impact zones expected during each phase. Sound levels from onsite and offsite activity including traffic on highways and railroad routes are presented in isopleth maps. A description of the Environmental Noise Prediction Model used for the study, the study basis and methodologies, and actual modeling data are provided. Noise and vibration levels from blasting are also predicted and evaluated. Protective noise criteria containing a margin of safety are used in relation to residences, schools, churches, noise-sensitive recreation areas, and noise-sensitive biological resources. Protective ground motion criteria for ruins and delicate rock formation in Canyonlands National Park and for human annoyance are used in the evaluation of blasting. The evaluations provide the basis for assessing the noise impacts from the related activities at the proposed repository. 45 refs., 21 figs., 15 tabs.

46336 (BMI/ONWI/C—19) Literature survey on solid and aqueous species of importance for nuclear waste repositories: The elements uranium, neptunium and cesium. Bucher, J.J. (Battelle Memorial Inst., Columbus, OH (USA). Office of Nuclear Waste Isolation; Lawrence Berkeley Lab., CA (USA)). 11 May 1987. Contract AC02-87CH10290;AC03-76SF00098. 319p. H. Order Number TI88013693/JAW.

This document contains extensive tables listing all possible chemical compounds of species that might occur in a proposed nuclear waste repository. Most are listed as unlikely to occur under conditions predicted for the repository. Extensive data tables and reference sources are provided for those compounds that might occur on form. (TEM)

46337 (BMI/ONWI/C—24) Noise source emissions, Davis Canyon site, Utah. (Battelle Memorial Inst., Columbus, OH (USA). Office of Nuclear Waste Isolation; Battelle Memorial Inst., Columbus, OH (USA)). Jul 1987. Contract AC02-87CH10290. 623p. (BMI/ONWI—694). H. Order Number DE88013696/JAW.

This report has been prepared for the purpose of documenting the development of the data provided to the Repository Project Management (RPM) organization. The data provided encompass all phases of activity, from site preparation through the exploratory shaft facility (ESF) and repository construction and operation, and decommissioning. Noise environments expected from construction and operation of transportation corridors associated with the activity were also modeled. The data for the construction of transportation corridors were provided by Bechtel National, Inc. Use of the quietest equipment available within the proven state of the art was assumed, as was the use of acoustical enclosures to the extent practical. The programmatic assumptions are based on the noise-sensitive nature of the Canyonlands National Park. Another feature of the data is the use of 1/3-octave-band rather than 1/1-octave-band resolution of emission spectra. This was done to permit evaluation of audibility of sounds reaching the park.

46338 (BMI/ONWI/C—30) [Survey of solid species]. Rizkalla, E.N.; Choppin, G.R. (Battelle Memorial Inst., Columbus, OH (USA). Office of Nuclear Waste Isolation; Florida State Univ., Tallahassee (USA). Dept. of Chemistry). [Mar 1988]. Contract AC02-87CH10290. 9p. H. Order Number TI88013314/JAW.

For complete characterization of a particular repository site, a full assessment of each of these individual parameters is required. In general, theoretical predictions on the nature of the insoluble compounds and the speciation of the soluble complexes in brine solutions can be obtained, if the standard chemical data are available over a reasonable range of temperature and ionic strength. The objective of the present study is to survey all the possible known solid species containing the element of interest which can exist geochemically and then to identify those of controlling limiting solubilities. The final task involve an assessment of the current data on the solubilities of these species and discussion of the needs for additional measurements to achieve a better understanding to develop the technology necessary to meet the requirements for licensing a repository site. A parallel survey has also been conducted to identify the possible existing aqueous species formed between the radionuclides and the relevant constituents expected to be present in the ground water. 2 refs., 1 fig., 1 tab.

46339 (BMI/ONWI/C—34) Salt Repository Project site study plan for seismographic monitoring: Revision 1. (Battelle Memorial Inst., Columbus, OH (USA). Office of Nuclear Waste Isolation; Stone and Webster Engineering Corp., Boston, MA (USA)). 22 Dec 1987. Contract AC02-87CH10290. 70p. H. Order Number TI88013306/JAW.

This site study plan describes the seismographic monitoring activities to be conducted during the early stages of Site Characterization at the Deaf Smith County site, Texas. The field programs has been designed to provide data useful in addressing information/data needs resulting from Federal/State/local regulatory requirements and repository program requirements. Sixteen new and three relocated seismographic stations will be added to the now existing network of 13 stations for a total of 32 stations in the network. The areal extent is being expanded and selected regions covered more densely to provide more accurate monitoring and location of microearthquakes. More sophisticated instruments are being used at selected locations to allow for more detailed analysis. A few seismographs are being installed at depth to provide a limited 3-D monitoring network in the area of the repository. The Salt Repository Project (SRP) Networks specify the schedule under which the program will operate. The Technique Field Services Contractor (TFSC) is responsible for conducting the field program. Data will be handled and reported in accordance with established SRP procedures. A quality assurance program will be utilized to assure that activities affecting quality are performed correctly and that appropriate documentation is maintained. 32 refs., 11 figs., 4 tabs.

46340 (BMI/ONWI/C—62) SIMMINE 1.0: A simulation model for subsurface mining operations. Furr, J.M.; Bennett, S.R.; Clark, G.M. (Battelle Memorial Inst., Columbus, OH (USA). Office of Nuclear Waste Isolation). 1 Oct 1987. Contract AC02-87CH10290. 114p. OSTI, PO Bx 62, Oak Ridge, TN 3783106. Order Number TI88013292/JAW.

SIMMINE 1.0 is a discrete event computer simulation of the salt mining operations of a typical subpanel of a geological high-level nuclear waste repository. The program models the major equipment used to mine the underground emplacement rooms in the repository. This equipment includes the miner, the shuttle cars (haulers), the feeder/breaker unit (tailpiece), and the roofbolter. Breakdown and repair features are included in the model. The model can also represent the simulation graphically using SIMANI-

MATION, a graphics package available with PC SIMSCRIPT II.5. Input data sets can be modified with DATAMINE, a simple, menu-driven, front-end. The applications of the techniques and principles of discrete event simulation to the design of automated industrial manufacturing technologies have been exhaustively discussed in several texts. The practice of simulation involves creating physical entities and generating events by means of stochastic samplings from well-known statistical distributions. The temporal flow of the created entities through the system under study is tracked by the simulation model to identify possible sources of queue formations that may lead to the development of costly bottlenecks in the system. The ultimate goal of the simulation model is the optimal allocation of the required mining resources for any desired subsurface panel layout. 13 refs., 17 figs.

46341 (BMI/ONWI/C—82) Technical procedures for implementation of aesthetics site studies, Deaf Smith County site, Texas: Environmental Field Program. (Battelle Memorial Inst., Columbus, OH (USA). Office of Nuclear Waste Isolation). Jun 1987. Contract AC02-87CH10290. 160p. H. Order Number DE88013293/JAW.

This chapter introduces the purpose and scope of the visually affected areas determination, as well as definitions, interfaces, and concurrent data needs. This procedure provides a method for determining the extent of visibility of the project. This area is identified as the visually affected area, and becomes the area within which all visual analysis is conducted. The visually affected area analysis of the Deaf Smith County site will involve identifying and mapping the visibility of all major proposed project features. Baseline analysis will be conducted within the overall visually affected area; impact assessment will be conducted within the visually affected area of each major project feature. This procedure presents the guidelines for determining the visually affected area will be in computer data base construction; viewshed modeling, and site visit and verification of results. Computer data base construction will involve digitizing topographic and project facility data from available data source. The extent of the visible area from each major project feature will then be plotted. Finally, these computer-generated visibility plots will be verified in the field.

46342 (BMI/ONWI/C—83) Technical procedures for implementation of background environmental radioactivity site studies, Deaf Smith County site, Texas: Environmental Field Program: Preliminary draft. (Battelle Memorial Inst., Columbus, OH (USA). Office of Nuclear Waste Isolation; NUS Corp., Gaithersburg, MD (USA)). Sep 1987. Contract AC02-87CH10290. 465p. H. Order Number DE88013307/JAW.

The purpose of this technical procedure is to describe the method for performing field maintenance on low-volume air samplers and the associated topics of personnel and organization, procedure preparation, documentation, and quality assurance. The scope of this procedure includes the maintenance of low-volume air samplers in the field and does not encompass maintenance performed by the manufacturer.

46343 (BMI/ONWI/C—85) Technical procedures for land use, Deaf Smith County site, Texas: Environmental Field Program: Final draft. (Battelle Memorial Inst., Columbus, OH (USA). Office of Nuclear Waste Isolation; Morrison-Knudsen Engineers, Inc., Denver, CO (USA); ERT, Inc., Pittsburgh, PA (USA)). Sep 1987. Contract AC02-87CH10290;AC02-83CH10140. 151p. H. Order Number TI88013308/JAW.

This volume contains Technical Procedures pursuant to the Land Use Site Study Plan including land use data acquisition, land use/land cover map compilation, verification of land use/land cover map accuracy, and land use/land cover data analysis. 22 refs., 5 figs.

46344 (BMI/ONWI/C—99(2)) Technical procedures for water resources, Deaf Smith County site, Texas: Volume 2: Environmental Field Program: Final draft. (Battelle Memorial Inst., Columbus, OH (USA). Office of Nuclear Waste Isolation; Morrison-Knudsen Engineers, Inc., Denver, CO (USA)). Aug 1987. Contract AC02-87CH10290. 298p. H. Order Number TI88014254/JAW.

This volume contains the following Technical Procedures pursuant to the Water Resources Site Study Plan operation of a Playa Lake conductivity monitoring station and processing of data from a Playa Lake conductivity monitoring station. This procedure defines steps and methods for the installation, operation, and maintenance of the Playa Lake conductivity monitoring stations. Conductivity measurements will be taken at six playa lakes in the site study area to record changes in total dissolved solids as a function of stage. Playa lake conductivity and stage (volume) measurements will be used, in conjunction with other water quality data collected at the Playa Lake and precipitation stations, to determine the mass of dissolved solids entering and leaving the playas. This baseline information on the pollutant mass balance of the playas will be used to assess potential changes in playa lake water quality and the magnitude of those changes due to site development. The pollutant mass balances will also be used on determining the source of pollutants. 2 refs., 5 figs.

46345 (BMI/ONWI/C—106) Final report on Paradox Basin/Gulf Interior: Regulatory project management. (Battelle Memorial Inst., Columbus, OH (USA). Office of Nuclear Waste Isolation; Bechtel National, Inc., San Francisco, CA (USA)). Dec 1986. Contract AC02-87CH10290. 138p. H. Order Number TI88013700/JAW.

This final report on the Regulatory Project Manager (RPM) program begins with a discussion of the key products produced during the 9-year effort and then focuses on the work performed in the major disciplines. The report then discusses the management of the work effort and the Quality Assurance (QA) program. It concludes with a brief discussion of the records turned over to the Office of Nuclear Waste Isolation (ONWI) at the conclusion of the work. 14 figs., 14 tabs.

46346 (BMI/ONWI/C—108) SCP Tools user's guide: A knowledge base toolbox for documenting relationships among high-level issues and site studies planned for characterization of a repository site. Korns, D.E.; Troy, K.S. (Battelle Memorial Inst., Columbus, OH (USA). Office of Nuclear Waste Isolation; Science Applications International Corp., Columbus, OH (USA)). Mar 1988. Contract AC02-87CH10290. 289p. H. Order Number TI88013694/JAW.

This document describes a personal computer knowledge base system that ranges from issue identification to performance allocation of mined geologic disposal system site characteristics. With SCP Tools, a user can describe a system configuration, identify information needs and parameters and allocate performance of selected system characteristics. SCP Tools allows the user to define information needs for resolution of an issue; parameters required for an information need; measures of performance for parameters, and then link supporting parameters to performance parameters and performance parameters to performance measures. All this is done with computer tools that create non-redundant facts stored in a knowledge base. Unlike most information systems, the SCP Tools remember which facts were already collected, thus allowing greater flexibility and speed in appending facts and reducing the amount of hard disk storage.

46347 (BMI/ONWI/C—110) Palo Duro seismographic network operation for July to December 1985: Report No. 4, Revision 1. Acharya, H. (Battelle Memorial Inst., Columbus, OH (USA). Office of Nuclear Waste Isolation). Sep 1987. Contract AC02-87CH10290. 89p. H. Order Number TI88013695/JAW.

A seismographic network operates in the Texas Panhandle to monitor earthquake activity in the area. This report describes the network and its operation, as well as analysis of data obtained during the period of July 1 to December 31, 1985. The network continued to operate satisfactorily during this period. The Mansfield Station continued to detect a number of very small earthquakes occurring near the station, but it was not possible to locate them since no other station detected them. All elements of the seismographic network were tested and checked in August and December, as part of the Stone & Webster Engineering Corporation quarterly maintenance program. The seismographic network now consist of 16 seismic stations, 4 relay stations, and 1 Central Re-

cording Station. Equipment at two stations was severely damaged from flooding, and the two stations were inoperative for some time. No valuable data loss occurred during this time. 11 refs., 8 figs., 9 tabs.

46348 (BMI/ONWI/C—112) Documentation for the computer program BRINETEMP. Zellmer, R.J. (Battelle Memorial Inst., Columbus, OH (USA). Office of Nuclear Waste Isolation). 27 Apr 1988. Contract AC02-87CH10290. 36p. H. Order Number TI88014261/JAW.

This report discusses this program and is intended to be the documentation for the code. The computer program BRINETEMP is a combination of both TEMP and BRINEMIG. However, there are some differences between BRINETEMP and the other two programs. There are two main differences between BRINETEMP and TEMP. BRINETEMP can not really handle an infinite array of heat sources. It approximates this by using a maximum of 3000 sources and averaging the temperature over a spherical shell in which the inner sphere has radius just outside that of the farthest source of the 3000 sources and the outer sphere has a radius equal to the maximum radius chosen for the problem being considered (theoretically this would be infinity). Also, for long times and close in to the source (package) being considered, BRINETEMP calculates the temperature using a quasi-steady state technique which is slightly different than that used in TEMP. The main difference in the brine migration calculations is that BRINETEMP uses analytical and semi-analytical methods rather than finite-difference methods to calculate the temperature and temperature gradients and therefore the brine velocities and flow. 13 refs., 3 figs., 1 tab.

46349 (BMI/ONWI/C—118(2)-Rev.0) Design parameters and source terms: Volume 2, Source terms: Revision 0. (Battelle Memorial Inst., Columbus, OH (USA). Office of Nuclear Waste Isolation; Fluor Technology, Inc., Irvine, CA (USA). Advanced Technology Div.). Oct 1987. Contract AC02-83WM46656;AC02-87CH10290. 305p. H. Order Number DE88013736/JAW.

The Design Parameters and Source Terms Document was prepared in accordance with DOE request and to provide data for the environmental impact study to be performed in the future for the Deaf Smith County, Texas site for a nuclear waste repository in salt. This document updates a previous unpublished report by Stearns Catalytic Corporation (SCC), entitled "Design Parameters and Source Terms for a Two-Phase Repository Salt," 1985, to the level of the Site Characterization Plan - Conceptual Design Report. The previous unpublished SCC Study identifies the data needs for the Environmental Assessment effort for seven possible Salt Repository sites. 2 tabs.

46350 (BMI/ONWI/C—134) Basic repository environmental assessment design basis, Swisher County Site. (Battelle Memorial Inst., Columbus, OH (USA). Office of Nuclear Waste Isolation). 1987. Contract AC02-87CH10290. 177p. H. Order Number TI88014257/JAW.

This study examines the engineering factors and costs associated with the construction, operation, and decommissioning of a high-level nuclear waste repository in salt in the Palo Duro Basin in Swisher County, Texas. The study assumes a repository capacity of 36,000 metric tons of heavy metal (MTHM) of unreprocessed spent fuel and 36,000 MTHM of commercial high-level reprocessing waste, along with 7020 canisters of defense high-level reprocessing waste and associated quantities of remote- and contact-handled transuranic waste (TRU). With the exception of TRU, all the waste forms are placed in 300- to 1000-year-life carbon-steel waste packages in a collocated waste handling and packaging facility (WHPF), which is also described. The construction, operation, and decommissioning of the proposed repository is estimated to cost approximately $4.6 billion. Costs include those for the collocated WMPF, engineering, and contingency but exclude waste form assembly and shipment to the site and waste package fabrication and shipment to the site. These costs reflect the relative average wage rates of the region, the relatively easy access to the site, and the relatively weak nature of the salt at this site. Construction would require an estimated 7 years. Engineering factors and costs are not strongly influenced by environmental considerations.

46351 (BMI/ONWI/C—137) Basic repository source term and data sheet report: Richton Dome. (Battelle Memorial Inst., Columbus, OH (USA). Office of Nuclear Waste Isolation; Stearns Catalytic Corp., Denver, CO (USA)). 1988. Contract AC02-87CH10290. 75p. H. Order Number TI88014259/JAW.

This report is one of a series describing studies undertaken in support of the US department of Energy Civilian Radioactive Waste Management (CRWM) Program. This study contains the derivation of values for environmental source terms and resources consumed for a CRWM repository. Estimates include heavy construction equipment; support equipment; shaft-sinking equipment; transportation equipment; and consumption of fuel, water, electricity, and natural gas. Data are presented for construction and operation at an assumed site in Perry County, Mississippi. 3 refs., 6 tabs.

46352 (BMI/ONWI/C—141) Biaxial borehole stressmeter installation and monitoring procedure: Final draft. (Battelle Memorial Inst., Columbus, OH (USA). Office of Nuclear Waste Isolation; Golder Associates, Inc., Redmond, WA (USA)). Oct 1986. Contract AC02-87CH10290;AC02-83CH10140. 41p. H. Order Number TI88014271/JAW.

Stress changes will be monitored in salt as part of facility-wide mechanical response monitoring and as part of several large-scale geochemical and thermomechanical tests. Of particular interest are the magnitudes of stresses resulting from repository activities such as excavation and thermal loading from emplaced waste, as well as time-dependent stress change associated with salt creep. This information affects various aspects of repository design and performance assessment, including: accuracy of predictive models and constitutive laws for salt used to evaluate long-term repository performance; external loads on the waste package; consolidation times for crushed salt backfill, both around the waste package and in the underground rooms, which in turn affect retrievability and long-term isolation capability; external loads on decommissioning seals, particularly those in the repository horizon; interpretation of results from other types of instruments, such as borehole extensometers; and maintenance requirements for underground openings during the operational phase of the repository. 4 refs., 8 figs., 1 tab.

46353 (BMI/ONWI/C—142) Bitumen pressure cell installation and monitoring procedure: Draft. (Battelle Memorial Inst., Columbus, OH (USA). Office of Nuclear Waste Isolation; Golder Associates, Inc., Redmond, WA (USA)). Feb 1987. Contract AC02-87CH10290. 25p. H. Order Number TI88014270/JAW.

A 6-in. (150-mm)-thick bitumen layer will be placed between the upper shaft preliminary concrete lining and the steel lining component of the final lining. The function of this layer is twofold; first, it will act as a compliant sealing layer which, because of the bitumen's fluid properties, will remain effective even if the concrete and steel lining components suffer significant strains; and second, it will help to ensure a uniform transmission of rock or hydrostatic loads to the inner lining components. A type 200–300 penetration grade bitumen (ASTM D946) will be used, with 32% by weight of added limestone flour. The purpose of the limestone flour is to ensure that the bitumen has a density which is greater than that of the formation fluids, resulting in a positive pressure gradient from the bitumen to the ground water. The resulting mixture will have a specific gravity of about 1.25 at 60{degree}F (15{degree}C). Pressure measurements in the bitumen layer are needed in order to determine loads on the inner lining components. Although some initial loading will occur in response to excavation, full rock and hydrostatic loads will not develop until post-construction thawing of the freeze wall is complete. Loads transmitted by the bitumen layer to the other lining components will be those which act radially, i.e., the bitustatic pressure, or the radial stress if deviatoric stresses develop.

46354 (BMI/ONWI/C—143) Blast vibration monitoring test procedure. (Battelle Memorial Inst., Columbus, OH (USA). Office of Nuclear Waste Isolation; Golder Associates, Inc., Redmond, WA (USA)). May 1986. Contract AC02-87CH10290. 20p. H. Order Number TI88014269/JAW.

Blast vibration monitoring will be performed in the Exploratory Shaft Facility (ESF) to measure the vibration produced by constructed blasting during shaft excavation. The monitoring will record the particle velocity generated by the construction blasts and will provide data to determine if the vibration design specifications for the shaft instrumentation and lining have been exceeded. Blast vibration monitoring will be limited to the measurement of the three orthogonal components of motion using seismometers located in each shaft. Monitoring shall be done in conjunction with the shaft uphole seismic testing. 3 figs.

46355 (BMI/ONWI/C—144) CFEST-BRINEMIG controlled version of version 1.0. McNulty, E.G. (Battelle Memorial Inst., Columbus, OH (USA). Office of Nuclear Waste Isolation). Mar 1987. Contract AC02-87CH10290. 127p. H. Order Number TI88014268/JAW.

This memorandum describes changes required to update CFEST code and documentation for brine migration according to the Jenks equation. This memorandum requests that the new code CFEST-BRINEMIG to put under code custodian control. This version will be delivered to Science Applications International Corporation (SAIC). This memorandum serves as the TMP-12 reports for CFEST-BRIMEMIG. It also discusses the changes and examples for the update version called CFEST-BRINEMIG. It also discusses the changes and examples for the update version called CFEST-BRINEMIG including changes made to CFEST Version 1.0, changes to CFEST User's Manual, brief description of mathematical models and numerical methods, sample input and output and problem description, description of verifications of CFEST-BRINEMIG and tapes index for codes and data to be put under code custodian control. Changes made to CFEST Version 1.0 involved only subprograms LKXYZ and LPROG3. Tables 1 and 2 give the differences of both these program. Similarly, change made to CFEST User's Guide involved only subprograms LKXYZ and LPROG3 as well. Tables 3 and 4 give the status of both the inputs for subprograms LKXYZ and LPROG3.

46356 (BMI/ONWI/C—151) Design review completion report for Exploratory Shaft Facility: Title I design. Comar, M.M. (Battelle Memorial Inst., Columbus, OH (USA). Office of Nuclear Waste Isolation). 13 Mar 1986. Contract AC02-87CH10290. 307p. H. Order Number TI88014282/JAW.

This design review completion report is the formal documentation that concludes the design review of the ESF Title I design in accordance with PMP (05). This report contains the summary conclusion of the design review, including the responses to all design review comments identified in the earlier finding report.

46357 (BMI/ONWI/C—152) Concrete strain gage in concrete shaft lining: Installation and monitoring procedure: Final draft. (Battelle Memorial Inst., Columbus, OH (USA). Office of Nuclear Waste Isolation; Golder Associates, Inc., Redmond, WA (USA)). Sep 1987. Contract AC02-87CH10290. 39p. H. Order Number TI88014281/JAW.

A cast-in-place concrete or concrete block preliminary lining component and a cast-in-place final concrete lining form part of the shaft lining system. Strain measurements within the cast-in-place concrete linings will be obtained using a concrete strain gage (CSG). This gage consists of a vibrating wire sensor and anchors embedded in the concrete during casting CSGs will be installed in both exploratory shafts. The primary objective of the overall monitoring program, of which these gages constitute one part, is to define the stress-deformation behavior of the shaft lining, seals, and foundations during and after construction. For this purpose it is necessary to consider the CSG embedded in the concrete as one element of an integrated program of monitoring the mechanical and thermomechanical response of the shaft. Other instruments that form part of this program include concrete stress meters, steel strain gages on the steel shaft liner, convergence gages, piezometers, joint meters, bitumen pressure gages, temperature detectors, and extensometers. For a justification and basis for design of the instrument arrays which form part of the Shaft Mechanical and Thermal Response Monitoring, refer to the Draft Shaft Study Plan. 8 figs.

46358 (BMI/ONWI/C—153) Concrete stress meter in concrete shaft lining: Installation and monitoring procedure: Draft. (Battelle Memorial Inst., Columbus, OH (USA). Office of Nuclear Waste Isolation; Golder Associates, Inc., Redmond, WA (USA)). Jun 1987. Contract AC02-87CH10290;AC02-83CH10140. 63p. H. Order Number TI88014280/JAW.

A cast-in-place concrete or concrete block preliminary lining component and a cast-in-place final concrete lining form part of the shaft lining system. Stress measurements within the cast-in-place concrete lining will be obtained using a concrete stress meter (CSM). This meter consists of mercury-filled flat hydraulic capsule with an integrated vibrating wire pressure transducer and is embedded in the concrete during casting. CSMs will be installed in both exploratory shafts. The primary objective of the overall monitoring program, of which these meters constitute one part, is to define the stress-deformation behavior of the shaft lining, seals, and foundations during and after construction. For this purpose it is necessary to consider the CSM embedded in the concrete as one element of an integrated program of monitoring the mechanical and thermomechanical response of the shaft. Other instruments that form part of this program include concrete strain gages, steel strain gages on the steel shaft liner, convergence gages, piezometers, joint meters, bitumen pressure gages, temperature detectors, and extensometers. For a justification and basis for design of the instrument arrays which form part of the Shaft Mechanical and Thermal Response Monitoring, refer to the Draft Study Plan. 8 figs.

46359 (CEGB-TPRD/B—1009/R87) Mechanisms of wet oxidation by hydrogen peroxide. Baxter, R.A. (Central Electricity Generating Board, Berkeley (UK). Berkeley Nuclear Labs.). Aug 1987. 31p. NTIS (US Sales Only), PC A03/MF A01. Order Number DE88754272/JAW.

A research programme is currently under way at BNL and MEL to investigate the possible use of hydrogen peroxide with metal ion catalysts as a wet oxidation treatment system for CEGB organic radioactive wastes. The published literature relating to the kinetics and mechanism of oxidation and decomposition reactions of hydrogen peroxide is reviewed and the links with practical waste management by wet oxidation are examined. Alternative wet oxidation systems are described and the similarities to the CEGB research effort are noted.

46360 (CEGB-TPRD/B—1042/R88) Methods of removal of tritium from aqueous effluent: a review of international research and development. Segal, M.G. (Central Electricity Generating Board, Berkeley (UK). Berkeley Nuclear Labs.). Jan 1988. 41p. NTIS (US Sales Only), PC A03/MF A01. Order Number DE88754279/JAW.

Tritium is formed in thermal nuclear reactors both by neutron activation of elements such as deuterium and lithium and by ternary fission in the fuel. It is a weak beta-emitter with a short half-life, 12.3 years, and its radiological significance in reactor discharges is very low. In heavy-water-cooled and -moderated reactors, such as the CANDU stations, the tritium concentration in the moderator is sufficiently high to cause a potential hazard to operators, and so a major research and development programme has been carried out on processes to remove the tritium. Detritiation of light water has also been the subject of major R and D effort world-wide, because reprocessing operations can generate significant quantities of tritium in liquid waste, and high concentrations of tritium may arise in some aqueous streams in fusion reactors. This Report presents a review of the methods that have been proposed, studied and developed for removal of tritium from light and heavy water: the principles of individual methods are discussed, and the current status of their development is reviewed.

46361 (DOE/CH/46664—03(2)) Permian Basin, Texas: Volume 2, Engineering drawings: Final preliminary design report. (Parsons Brinckerhoff, Houston, TX (USA)). Jan 1988. Contract AC02-87CH10290;AC97-86WM46664. 119p. (BMI/ONWI/C—77). H. Order Number TI88013315/JAW.

This document contains 64 engineering drawings for the proposed exploratory shaft facility to be built in Deaf County, Texas. (TEM)

46362 **(DOE/ID/12576—T14) Regional Management Plan: Summary report.** Drobny, N.L. (Midwest Interstate Low-Level Radioactive Waste Commission, St. Paul, MN (USA); ERM-Midwest, Inc., Columbus, OH (USA)). 1 Aug 1986. Contract FG07-85ID12576. 101p. NTIS, PC A06/MF A01; 1; GPO Dep. Order Number DE88012163/JAW.

This summary report describes the results of a 16-month project to develop a Regional Management Plan for low-level radioactive waste management in a seven-state area. The seven states are Indiana, Iowa, Michigan, Minnesota, Missouri, Ohio, and Wisconsin. These states have formed the Midwest Interstate Low-Level Radioactive Waste Commission in accord with Congressional requirements established in 1980. What is low-level radioactive waste? Low-level radioactive waste results from the use of radioactive materials in the treatment of disease, the production of consumer goods and industrial products, and from the generation of electricity at nuclear power plants. Low-level wastes, which are a responsibility of the states, are grouped into three classes, A, B, and C; this classification scheme is prescribed by Federal Regulations and represents different degrees of hazard associated with different concentrations of radioactive materials. Class A wastes are the least hazardous. Classes B and C represent higher hazard classes. 14 refs., 13 figs., 9 tabs.

46363 **(DOE/NE/44347—2) [Review of draft Crystalline Repository Project reports]: Technical progress report, CY 1985-1986.** (Wisconsin Radioactive Waste Review Board, Madison (USA)). 1986. Contract FG02-83NE44347. 34p. NTIS, PC A03/MF A01; 1; GPO Dep. Order Number DE88013576/JAW.

During the period (CY 1985-86) of this report, the Wisconsin Radioactive Waste Review Board provided technical services under the contract with DOE. These included Participation in the development of variables and screening techniques that would be used in identifying those rock bodies in the Area Recommendation Report (ARR); reviewing and commenting on the report and developing a procedure in which local residents could have input into the process; sought resumption of negotiations with DOE on a full Consultation and Cooperation (C&C) agreement; and Participating in workshops and provided comments on two major DOE transportation documents, "Transportation Business Plan: Strategy Options Document," and "Transportation Institutional Plan."

46364 **(DOE/OR—859) The report of the Joint Task Force on Uranium Recycle Materials Processing.** (USDOE Oak Ridge Operations Office, TN). Sep 1985. 100p. NTIS, PC A05/MF A01; 1; GPO Dep. Order Number DE88012848/JAW.

A Joint Task Force on Uranium Recycle Materials Processing was assembled by the Department of Energy (DOE) to study past and current practices relating to the processing of uranium recycle materials at DOE's Feed Materials Production Center (FMPC), Oak Ridge Y-12 Plant, and the DOE operations at the RMI Company. The DOE facilities providing the uranium recycle material and selected end users of the recycle material were reviewed in a cursory manner. The Task Force determined that uranium recycle material produced by the DOE reprocessing sites will always contain trace levels of transuranics (e.g., plutonium and neptunium) and fission product (e.g., strontium and cesium) elements. However, the DOE processing sites such as the FMPC, Y-12 and RMI Company can safely handle and further process the recycle material if a clear understanding of the contaminant levels exists and available technology is utilized to assure environmental, safety, and health protection of both the plant worker and the general public. Irrespective of past practices, the Task Force judged that more attention should be given to the processing of uranium recycle material. The primary recommendation from this study is to develop formal specifications on maximum permissible levels of contaminants in feed materials. 6 figs., 18 tabs.

46365 **(DOE/RL/11417—T1) Review of the grouting specification for the exploratory shaft, Basalt Waste Isolation Project (BWIP): Final report, [July 1987-February 1988].** Wakeley, L.D.; O'Neil, E.F. III; Boa, J.A. Jr. (Army Engineer Waterways Experiment Station, Vicksburg, MS (USA). Structures Lab.). Feb 1988. Contract AI06-87RL11417. 79p. NTIS, PC A05/MF A01; 1; GPO Dep. Order Number DE88014623/JAW.

An underground repository for commercially generated radioactive wastes was proposed for a site near Hanford, Washington. Plans for the exploratory shaft (ES) for this repository called for casing the hole and filling the lower portions of the annulus with an expansive cement grout. A non-expansive grout and chemical seals were to be used elsewhere in filling the annulus. This report is a review of the first (and only) grouting specifications for the ES. This report describes many aspects of formulation and use of expansive grouts and of grouting technology. It includes recommendations about appropriate grout materials, about the important properties of an expansive grout for this purpose, and about tests to quantify its properties. Factors which affect expansion, such as temperature, workability, time of setting, and use of aggregate and pozzolan, are discussed. 56 refs.

46366 **(DOE/RW—0184-Vol.7) Characteristics of spent fuel, high-level waste, and other radioactive wastes which may require long-term isolation.** (USDOE Office of Civilian Radioactive Waste Management, Washington, DC). Jun 1988. 194p. H. Order Number DE88011575/JAW.

The purpose of this report, and the information contained in the associated computerized data bases, is to establish the DOE/OCRWM reference characteristics of the radioactive waste materials that may be accepted by DOE for emplacement in the mined geologic disposal system as developed under the Nuclear Waste Policy Act of 1982. This report provides relevant technical data for use by DOE and its supporting contractors and is not intended to be a policy document. This document is backed up by five PC-compatible data bases, written in a user-oriented, menu-driven format, which were developed for this purpose.

46367 **(DOE/RW—0184-Vol.8) Characteristics of spent fuel, high-level waste, and other radioactive wastes which may require long-term isolation.** (USDOE Office of Civilian Radioactive Waste Management, Washington, DC). Jun 1988. 133p. H. Order Number DE88011574/JAW.

The purpose of this report, and the information contained in the associated computerized data bases, is to establish the DOE/OCRWM reference characteristics of the radioactive waste materials that may be accepted by DOE for emplacement in the mined geologic disposal system. This report provides relevant technical data for use by DOE and its supporting contractors and is not intended to be a policy document. This document is backed up by five PC-compatible data bases, written in a user-oriented, menu-driven format, which were developed for this purpose. The data bases are the LWR Assemblies Data Base; the LWR Radiological Data Base; the LWR Quantities Data Base; the LWR NEA Hardware Data Base; and the High-Level Waste Data Base. The above data bases may be ordered using the included form. An introductory information diskette can be found inside the back cover of this report. It provides a brief introduction to each of these five PC data bases. Volume 8 contains 4 appendices. 14 refs., 20 figs., 20 tabs.

46368 **(DOE/RW—0193) OCRWM [Office of Civilian Radioactive Waste Management] transportation program reference: Glossary, acronym list, bibliography.** (USDOE Office of Civilian Radioactive Waste Management, Washington, DC). Jul 1988. 28p. H. Order Number DE88013831/JAW.

A successful transportation system for nuclear waste must be safe, efficient, and widely acceptable. To achieve the necessary public understanding, there must be an exchange of information and an identification of issues. This booklet has been developed to assist in that exchange of information and help in the communication of issues. It will provide a glossary of commonly used terms, a list of acronyms, a bibliography selected from the public information developed by the OCRWM Program, and contacts for additional in-

formation. Transportation is an integral and essential part of the projected waste management system. The United States has a long history of transporting radioactive material. Commercial spent fuel has been shipped for over 20 years and high-level waste from defense activities for an even longer period. These shipments have been conducted without any accidents causing death or environmental damage because of the radiological nature of the cargo. DOE is taking measures to ensure that this safety record continues. 24 refs.

46369 (DOE/RW—0195) Managing the nation's nuclear waste. (USDOE Office of Civilian Radioactive Waste Management, Washington, DC). [1988]. 8p. H. Order Number DE88013796/JAW.

This document is a popular treatment of nuclear waste management. Organized in a question and answer format, this report provides a brief overview of current technology in facilities, storage methods, types and quantity of waste material, and regulations. (TEM)

46370 (DOE/WIPP—87-017-Vol.1) Geotechnical field data and analysis report, July 1986–June 1987: Volume 1. (Westinghouse Electric Corp., Carlsbad, NM (USA). Engineering and Repository Technology Dept.). Mar 1988. Contract AC04-86AL31950. 121p. NTIS, PC A06/MF A01; 1; GPO Dep. Order Number TI88013970/JAW.

The Geotechnical Field Data and Analysis Report (GFDAR) is prepared to provide a timely assessment of the geotechnical status of the Waste Isolation Pilot Plant (WIPP). During the period of shaft sinking and construction of the principal underground access and experimental areas, reporting was on a quarterly basis. Because geotechnical responses of existing underground facilities have slowed to nearly steady-state and excavation of the waste storage panels will take place more slowly and over an extended period, reporting in the coming years will be on an annual cycle. Volume I focuses on the performance of the various underground facilities including the three shafts, shaft stations, access drifts, test rooms, and waste storage areas. It provides a direct evaluation of the geotechnical aspects of performance in the context of the relevant design criteria. It provides projections of the future performance of these facilities. The results of stratigraphic mapping and the occurrence of gas and brine are also documented. The depth and breadth of analysis for the different underground facilities varies according to the types and quantities of data that are available, and the complexity of the recorded geotechnical responses. 45 figs., 15 tabs.

46371 (DP-MS—86-128) Development and demonstration of the DWPF [Defense Waste Processing Facility] canister decontamination process using frit slurry blasting. Harris, A.H.; Ward, C.R. (Savannah River Lab., Aiken, SC (USA)). 1986. Contract AC09-76SR00001. 13p. (CONF-860905—37). NTIS, PC A03/MF A01; 1; GPO Dep. Order Number DE88014306/JAW.

From International meeting on low, intermediate and high level waste management - decontamination and decommissioning; Niagara Falls, NY, USA (14 Sep 1986).

Stainless steel canisters will be filled with high-level radioactive waste glass in the Defense Waste Processing Facility (DWPF) at the Savannah River Plant. The canister surface must be decontaminated to an acceptable level before welding the permanent closure and transferring the canister to temporary storage. This will be accomplished by blasting with an air-injected glass frit slurry which will remove the contaminated brown oxide layer that is produced during glass pouring. The contaminated slurry from the decon process becomes feed for the melter, thereby producing no secondary waste. Development of the equipment design, blasting sequence, and process parameters was achieved by testing a full-scale Experimental Canister Frit Blaster. The design improvements were incorporated in the fabrication of the remotely operated DWPF Canister Decontamination Chambers. Demonstration of these improvements and the additional equipment in the first CDC will be accomplished through operability testing at the Equipment Test Facility. 5 refs., 6 figs., 1 tab.

46372 (DPST—86-268) Hydraulic properties of saltstone and Z-Area soil. Cook, J.R.; Langton, C.A.; Wilhite, E.L. (Savannah River Lab., Aiken, SC (USA)). 4 Apr 1986. Contract AC09-76SR00001. 19p. NTIS, PC A03/MF A01; 1; GPO Dep. Order Number DE88014305/JAW.

Basic hydraulic characteristics of disturbed and undisturbed Z-Area soil and of sandstone have been obtained. These data will aid modeling of the release of soluble ions from saltstone after disposal. Modeling of the release of soluble ions from saltstone and the migration of those materials to the water table has been underway for some time. Data needed for modeling were inferred from data available on burial ground soils and soils near Z-Area. To improve the accuracy of modeling, the hydraulic properties of Z-Area soil and saltstone were measured. A report is attached; results are summarized below. 7 refs., 7 figs. 1 tab.

46373 (DPST—88-307) 1987 Environmental Sciences Division environmental activities. Moore, D.B.; Holmes, W.G. (comps.). (Savannah River Lab., Aiken, SC (USA)). 26 Jan 1988. Contract AC09-76SR00001. 21p. NTIS, PC A03/MF A01; 1; GPO Dep. Order Number DE88014495/JAW.

This document contains an evaluation on Savannah River Plant's effort to meet permit or environmental impact requirements. Included are programs in waste management and ground water flow models, alternative cooling water environmental impact statements, remote sensing, microbiology, and seismic surveys. (TEM)

46374 (EPRI-NP—5786) Pretreatments and selective materials for improved processing of PWR [Pressurized Water Reactor] liquid radioactive wastes: Final report. Propst, R.M.; Ekechukwu, O.E.; Dameron, H.J.; Ward, G.L.; Atherton, N.G. (Electric Power Research Inst., Palo Alto, CA (USA); Duke Power Co., Charlotte, NC (USA)). Jul 1988. 585p. Research Reports Center, Box 50490, Palo Alto, CA 94303. Order Number TI88014205/JAW.

This project was an exploratory study of liquid radwaste treatment techniques. Bench-scale tests were conducted on various sorption materials and pretreatment agents. Pretreatments included ultrafiltration, oxidation, reduction, complexation, coagulation, flocculation, and pH adjustment. Sorption materials included ion exchange resins, zeolites, carbons, polymeric adsorbents, and newly developed unique ion-exchangers. Project results indicate that: (1) For cesium removal, zeolites were found to be effective and low in process cost. (2) For iodine, any good quality strong base anion exchange resin was effective and low in process cost. Cobalt removal was found to be more complex: Cobalt and other transition metal radionuclides exist as both ions (positively and negatively charged) and colloidal particles. For cobalt removal, strong acid cation exchange resins produced the most reliable results at the lowest estimated cost. Other useful cobalt and transition metal results were achieved by: ultrafiltration pretreatment followed by ion exchange; coagulating polyelectrolyte followed by mixed bed ion exchange; and coarse-crushed ion exchange resins. Processing techniques developed in the project have been scaled up and used at two operating PWRs since April 1984. 51 figs., 106 tabs.

46375 (HEDL—7661) Environmentally assisted cracking behavior of a candidate basalt repository container material in ground water undergoing gamma irradiation. James, L.A. (Westinghouse Hanford Co., Richland, WA (USA)). Apr 1987. Contract AC06-87RL10930. 42p. NTIS, PC A03/MF A01; 1; GPO Dep. Order Number DE88013530/JAW.

Fatigue-crack propagation tests were conducted on a candidate basalt repository container material (ASTN A27 steel) tested in Hanford groundwater at 150{degree}C. Tests were run on groups of identical specimens undergoing gamma irradiation and control specimens not exposed to irradiation. The gamma flux levels (approx. 123 rad/hour) were prototypic of those expected at the outer surface of the waste container. A statistical evaluation suggested that there were no significant differences between crack growth rates in the unirradiated and irradiated specimens. 32 refs., 18 figs., 4 tabs.

46376 (INIS-mf—11704) **Management and disposal of spent nuclear fuel. Review of a programme for research, development and other measures.** (National Board for Spent Nuclear Fuel, Stockholm (Sweden)). May 1987. 144p. NTIS (US Sales Only), PC A07/MF A01. Order Number DE88754362/JAW.

The programme consists of the long-term and short-term programme, the continued bedrock investigations, the underground research laboratory, the decision-making procedure in the site selection process and information questions during the site selection process. The National Board for Spent Nuclear Fuel hereby subunits both the SKB's R and D Programme 86 and the Board's statement concerning the programme. Decisions in the matter have been made by the Board's executive committee.

46377 (INIS-mf—11733) **Tritium upgrading in the aqueous waste streams of nuclear fuel reprocessing plant. Final report.** Mangold, H.; Schindewolf, U. (Bundesministerium fuer Forschung und Technologie, Bonn (Germany, F.R.)). [1988]. 161p. (In German). NTIS (US Sales Only), PC A08/MF A01. Order Number DE88754593/JAW.

The CECE process for tritium upgrading in the aqueous tails stream of nuclear fuel reprocessing plant is explained here with particular regard to improvements made. By the improved process, tritium is first upgraded to about the thirty-fold concentration, then highly upgraded (likewise about thirty times) in a hot-cold column system by means of catalytic isotope exchange. The hot column consists of a number of non-pressurized single stages. The required high temperatures are obtained by an electrically heated catalyst, -Pt very finely dispersed onto an activated carbon fabric -; characteristics and preparation are explained in detail. A semi-technical hot-cold system has been developed and tested with deuterium. The upgrading factor achieved correspond to the theory of the hot-cold system. A mathematical model using iterative techniques for evaluation has been developed, and has been used together with the experimental results for calculating the basic design features of a tritium upgrading system within a nuclear fuel reprocessing plant.

46378 (JSS-TR—87-01) **JSS project phase 4: Experimental and modelling studies of HLW glass dissolution in repository environments. Final report.** (Swedish Nuclear Fuel and Waste Management Co., Stockholm). Oct 1987. 295p. NTIS (US Sales Only), PC A13/MF A01. Order Number DE88754364/JAW.

A goal of the JSS project was to develop a scientific basis for understanding the effects of waste package components, groundwater chemistry, and other repository conditions on glass dissolution behaviour, and to develop and refine a model for the processes governing glass dissolution. The fourth phase of the project, which was performed by the Hahn-Meitner-Institut, Berlin, FRG, dealt specifically with model development and application. Phase 4 also adressed whether basaltic glasses could serve as natural analogues for nuclear waste glasses, thus providing a means to test the capability of the model for long-term predictions. Additional experiments were performed in order to complete the data base necessary to model interactions between the glass and bentonite and between glass and steel corrosion products. More data on temperature, S/V, and pH dependence of the glass/water reaction were also collected. In this report, the data acquired during phase 4 are presented and discussed.

46379 (MHSMP—88-09) **Soil fixative study progress report aerial application test:.** Teter, A.C. (Mason and Hanger-Silas Mason Co., Inc., Amarillo, TX (USA)). Mar 1988. Contract AC04-76DP00487. 8p. NTIS, PC A02/MF A01. Order Number DE88011504/JAW.

A soil fixative has been developed (a simple wheat flour paste mixture) and tested in the laboratory that appears suitable for the temporary fixation of radioactive dusts in case of an accidental spill. A limited field test was made and the feasibility of aircraft delivery examined. A videotape was made of the operations. 3 figs.

46380 (MLM—3511(OP)) **Improvements in efficiency, capacity, and reliability of Mound's effluent removal system.** Hedley, W.H.; Lamberger, P.H.; Gibbs, G.E.; Colvin, C.M. (Monsanto Research Corp., Miamisburg, OH (USA). Mound). 1988. Contract AC04-76DP00053. 4p. (CONF-880505—31). NTIS, PC A02/MF A01; 1; GPO Dep. Order Number DE88012881/JAW.

From 3. topical meeting on tritium technology in fission, fusion and isotopic applications; Toronto, Canada (1 May 1988).

Measurements at Mound have shown that the tritium capture system removes all but 500 curies per year of the 500,000 to 1,000,000 curies per year of tritium fed to it. Analyses of the gases emitted from the system show that over 95 percent of the escaping tritium has been in the form of organic tritium compounds. A new, more efficient reactor now oxidizes over 99 percent of the 5000 curies per year of organic tritium compounds fed to it (as compared to 90 percent by the existing reactors). The capacity and reliability of the system have also been improved by installing a new, larger, variable-speed compressor. 5 refs., 2 tabs.

46381 (NUREG/CR—4864-Vol.1) **Thermodynamic tables for nuclear waste isolation: Aqueous solutions database.** Phillips, S.L.; Hale, F.V.; Silvester, L.F.; Siegel, M.D. (Nuclear Regulatory Commission, Washington, DC (USA). Office of Nuclear Material Safety and Safeguards; Sandia National Labs., Albuquerque, NM (USA); Lawrence Berkeley Lab., CA (USA)). Jun 1988. Contract AC03-76SF00098;AC04-76DP00789. 181p. (LBL—22860-Vol.1; SAND—87-0323-Vol.1). NTIS, PC A09/MF A01 - GPO. Order Number TI88013650/JAW.

Tables of consistent thermodynamic property values for nuclear waste isolation are given. The tables include critically assessed values for Gibbs energy of formation, enthalpy of formation, entropy and heat capacity for minerals; solids; aqueous ions; ion pairs and complex ions of selected actinide and fission decay products at 25{degree}C and zero ionic strength. These intrinsic data are used to calculate equilibrium constants and standard potentials which are compared with typical experimental measurements and other work. Recommendations for additional research are given. 13 figs., 22 tabs.

46382 (PNL-SA—15217, pp 133-150) **Analysis of complex organic mixtures in nuclear wastes.** Toste, A.P.; Pahl, T.R.; Lucke, R.B.; Myers, R.B. 1987. NTIS, PC A99/MF A01. Order Number DE88007332/JAW. (CONF-851027—).

From 24. Hanford life sciences symposium and environmental research on complex organic mixtures; Richland, WA, USA (20 Oct 1985).

Nuclear wastes occasionally contain complex mixtures of organic compounds which may complicate their proper management and final disposal. The authors therefore characterized the organic content of four nuclear wastes; an organic-rich, complexant waste and three commercial wastes from nuclear power reactors. The organic complexant waste contained 44 g total organic carbon (TOC)/L, 40.3% of which consisted of complexing agents, chelating agents, and chelator fragments derived from the degradation of the chelating agents, at concentrations ranging from 0.23 mM to 64.39 mM. Some compounds were difficult to analyze because they form intramolecular lactones and lactams, complicating the interpretation of their mass spectra. Commercial wastes contained various hydrophobic and hydrophilic organic species at nanomolar and micromolar concentrations, respectively. Chelating agents and complexing agents were found in one commercial waste from a pressurized water reactor. The other two commercial wastes, from a boiling water reactor, contained alkylphenols, alkylphenyl phosphate esters, and a chelating agent. The presence of chelator fragments and other organic compounds indicates that organic diagenesis, or degradation, is widespread and vigorous in nuclear wastes.

46383 **(PTB-SE—19) Revision of the requirements on radioactive wastes to be disposed of in the planned Konrad repository by means of the program ANKONA.** Berg, H.P.; Fischer, H.; Piefke, F. (Physikalisch-Technische Bundesanstalt, Braunschweig (Germany, F.R.). Abt. Sicherstellung und Endlagerung Radioaktiver Abfaelle). Jan 1988. 102p. (In German). NTIS (US Sales Only), PC A06/MF A01. Order Number DE88754608/JAW.

Radioactive waste to be disposed of in the planned Konrad repository has to fulfil requirements which result from the analyses of the normal operation, of assumed incidents, of the thermal influence on the host rock and of the criticality safety. These requirements include limits of activity of groups of radionuclides and single radionuclides, which are determined by the properties of the waste packages. The program ANKONA was developed in order to examine the requirements by means of a personal computer. Only the necessary data of the waste package, for example the waste form group and the type of waste container, have to be provided. The result of the examination is displayed on the screen and optionally printed.

46384 **(SAND—87-1903) Summary of radioactive materials package stowage.** Gonzales, A. (Sandia National Labs., Albuquerque, NM (USA)). Jun 1988. Contract AC04-76DP00789. 176p. (TTC—0749). NTIS, PC A09. Order Number DE88014701/JAW.

A tiedown system is necessary to attach a package of radioactive materials to a transport vehicle, be it a truck trailer, railcar, or barge. National and international tiedown regulations are summarized and discussed in this paper. Experimental and analytical evaluations of tiedown loads and responses also are summarized, with particular emphasis on a joint French/Belgian program examining cask and tiedown responses under accident conditions. 14 refs., 9 figs., 2 tabs.

46385 **(SAND—87-7144) Time domain electromagnetic (TDEM) surveys at the WIPP [Waste Isolation Pilot Plant] site: Final report.** Cline, H.; Blohm, M. (Sandia National Labs., Albuquerque, NM (USA); Earth Technology Corp., Golden, CO (USA)). Jun 1988. Contract AC04-76DP00789. 41p. NTIS, PC A03/MF A01; 1; GPO Dep. Order Number DE88014190/JAW.

This report presents the results of a time domain electromagnetic (TDEM) survey over the location of the waste storage panels of the Waste Isolation Pilot Plant (WIPP) near Carlsbad, New Mexico. TDEM derives the geoelectric section (electrical resistivity layering) from surface measurements. The objective of the survey was to determine the occurrence and depth of brine in the geologic formations above and below the waste panels. Brine saturated layers and brine pockets have low values of electrical resistivity and, therefore, form good targets for detection by electrical geophysical methods. 8 refs., 26 figs.

46386 **(SAND—88-7001) Interpretation of hydraulic tests conducted in the waste-handling shaft at the Waste Isolation Pilot Plant (WIPP) site.** Saulnier, G.J. Jr.; Avis, J.D. (Sandia National Labs., Albuquerque, NM (USA); Intera Technologies, Inc., Austin, TX (USA)). Jul 1988. Contract AC04-76DP00789. 195p. NTIS, PC A09/MF A01; 1; GPO Dep. Order Number DE88014193/JAW.

A series of sub-horizontal boreholes from 8- to 41-feet deep were drilled from four depth levels in the waste-handling shaft at the Waste Isolation Pilot Plant (WIPP) site in southeastern New Mexico. The boreholes were drilled at the 782- and 805-foot depth levels in a mudstone and a claystone of the unnamed lower member of the upper Rustler Formation; at the 850-foot depth level in bedded halite in the upper Salado Formation; and at the 1350-foot depth level in halite, anhydrite, and polyhalite of the Salado Formation. Examination of the cores recovered from one borehole at each level indicated no direct evidence of construction-induced fracturing. Pulse-injection test were conducted in packer-isolated intervals in six of the boreholes to estimate the formations's hydraulic conductivity and apparent formation pressure, and to determine whether or not there was evidence of construction-enhanced permeability up to one shaft diameter from the shaft wall. 12 ref., 67 figs., 19 tabs.

46387 **(SKBF-KBS-SP-IR—84-01) [DECD/NEA Radioactive waste disposal project]. Annual report 1983.** (Swedish Nuclear Fuel Supply Co., Stockholm. Div. KBS). May 1984. 43p. NTIS (US Sales Only), PC A03/MF A01. Order Number DE88753660/JAW.

An autonomous OECD/NEA Project relating to the final disposal of highly radioactive waste from nuclear power generation is currently under way in an abandoned iron ore mine at Stripa, in central Sweden. Research is being performed in a granite formation 350 meters below ground. The first phase of the project, scheduled for completion in 1984, consists essentially of three parts: - hydrogeological and geochemical investigations in boreholes down to a depth of 1230 metres below the ground surface, tracer migration tests to study radionuclide transport mechanisms in the rock fractures, and large-scale tests of the behaviour of backfill material in deposition holes and tunnels. The second phase, started in 1983 and is scheduled for completion in 1986. The investigations included in the second phase are: development of crosshole geophysical and hydraulic methods for the detection and characterization of fracture zones - extended tracer experiments in fractured granite, and the sealing of boreholes and shafts, using highly compacted bentonite. The KBS Division of the Swedish Nuclear Fuel Supply Company acts as the host organization, and provides the management for the Project. It is responsible for mine operations and for the procurement of equipment and material for experimental work (G.B.).

46388 **(STRIPA-TR—87-06) Crosshole investigations - results from seismic borehole tomography.** Pihl, J.; Hammarstroem, M.; Ivansson, S.; Moren, P. (Foersvarets Forskningsanstalt, Stockholm (Sweden)). (Swedish Nuclear Fuel and Waste Management Co., Stockholm; Foersvarets Forskningsanstalt, Stockholm (Sweden)). Dec 1986. 86p. NTIS (US Sales Only), PC A05/MF A01. Order Number DE88754372/JAW.

The specially developed system for seismic tomography measurements has proved reliable and versatile in field work. The same equipment can be used for measurements from tens of metres up to a distance of 1000 m. The explosive source has proven reliable, in use although time-consuming. It can be used over the full range of distances. The quality of the tomographic analysis is strongly dependent on the areas under study. In homogeneous rock, and at moderate (i.e. up to 200 m) distances, high-precision tomograms can be obtained. On the other hand, if the rock is heterogeneous, and/or the measuring distance large, the many possible solutions make the interpretation difficult. Information from other types of investigations are then usually needed in order to obtain a satisfactory result. Three-dimensional measurements are possible, although time-consuming.

46389 **(STRIPA-TR—87-11) Crosshole investigations - results from borehole radar investigations.** Olsson, O.; Falk, L.; Sandberg, E.; Forslund, O.; Lundmark, L. (Sveriges Geologiska Undersoekning, Uppsala; Sveriges Geologiska Undersoekning, Malaa). (Swedish Nuclear Fuel and Waste Management Co., Stockholm; Sveriges Geologiska Undersoekning, Uppsala). May 1987. 268p. NTIS (US Sales Only), PC A12/MF A01. Order Number DE88754373/JAW.

A new borehole radar system has been designed, built and tested. The system consists of borehole transmitter and receiver probes, a signal control unit for communication with the borehole probes, and a computer unit for storage and display of data. The system can be used both in singlehole and crosshole modes and probing ranges of 115 m and 300 m, respectively, have been obtained at Stripa. The borehole radar is a short pulse system which uses center frequencies in the range 20 to 60 MHz. Single hole reflection measurements have been used to identify fracture zones and to determine their position and orientation. The travel time and amplitude of the first arrival measured in a crosshole experiment can be used as input data in a tomographic analysis.

46390 (STRIPA-TR—87-15) Hydrogeological characterization of the Stripa site. Gale, J.; Macleod, R.; Welhan, J.; Cole, C.; Vail, L. (Memorial Univ. of Newfoundland, St. John's (Canada); Battelle Pacific Northwest Labs., Richland, WA (USA)). (Swedish Nuclear Fuel and Waste Management Co., Stockholm; Memorial Univ. of Newfoundland, St. John's (Canada); Pacific Northwest Lab., Richland, WA (USA)). Jun 1987. 154p. NTIS (US Sales Only), PC A08/MF A01. Order Number DE88754374/JAW.

This study was initiated in January, 1986, to determine a) if the permeability of the rock mass in the immediate mine area was anisotropic, b) the effective and total fracture porosity distributions based on field and laboratory data and c) the three-dimensional configuration of the groundwater flow system at Stripa in order to properly interpret the hydrogeological, geochemical and isotopic data. The total and flow porosities of single fractures from Stripa were determined in the laboratory using a resin impregnation technique. The three-dimensional numerical model gave mine inflows that were consistent with the measured mine inflows with perturbations extending to at least 3,000 m of depth.

46391 (STRIPA-TR—87-17) Site characterization and validation - geophysical single hole logging. Stage 1. Fridh, B. (Sveriges Geologiska Undersoekning, Malaa). (Swedish Nuclear Fuel and Waste Management Co., Stockholm). Dec 1987. 91p. NTIS (US Sales Only), PC A05/MF A01. Order Number DE88754375/JAW.

Five 'boundary boreholes' have been drilled for preliminary characterization of a previously unexplored site at the 360 m level in the Stripa mine. Three of these boreholes are directed towards the North in the mine coordinate system, while two are directed towards the West. Furthermore, a vertical hole has been drilled at the end of the 3D-migration drift. To adequately describe the rock mass in the vicinity of these boreholes, a comprehensive program utilizing a large number of geophysical borehole methods has been carried out. The specific geophysical character of the rock mass and the major deformed units distinguished in the boreholes are recognized, and in certain cases also correlated between the boreholes.

46392 (TULEA—1986-02) Heat induced fracturing of rock in an existing uniaxial stress field. Mathis, J.; Stephansson, O.; Bjarnason, B.; Hakami, H.; Herdocia, A.; Mattila, U.; Singh, U.; Eriksson, L. (Luleaa Coll. and Inst. of Tech. (Sweden). Div. of Rock Mechanics). 1986. 128p. NTIS (US Sales Only), PC A07/MF A01. Order Number DE88753664/JAW.

This study was initiated under the premise that it may be possible to determine the state of stress in the earth's crust by heat induced fracturing of the rock surrounding a borehole. The theory involved is superficially simple, involving the superposition of the stress field around a borehole due to the existing virgin streases and the uniform stress field of thermally loaded rock as induced by a heater. Since the heat stress field is uniform, varying only in magnitude and gradient as a function of heater input, fracturing should be controlled by the non-uniform virgin stress field. To determine if the method was, in fact, feasible, a series of laboratory test were conducted. These tests consisted of physically loading center drilled cubes of rock, 0.3 m on a side, uniaxially from 0 to 25 MPa. The blocks were then thermally loaded with a nominally rated 3.7 kW heater until failure occurred. Results from these laboratory tests were then compared to analytical studies of the problem, i.e., finite element and discrete theoretical analysis. Overall, results were such that the method is likely eliminated as a stress measurement technique. The immediate development of a thermal compressive zone on the borehole wall overlaps the tensile zone created by the uniaxial stress field, forcing the failure is thus controlled largely by the power input of the heater, being retarded by the small compressive streases genrated by the uniaxial stress field. This small retardation effect is of such low magnitude that the retardation effect is of such low magnitude that the fracture time is relatively insensitive to the local virgin stress field. (authors).

46393 (UCRL—21048) Lawrence Livermore National Laboratory Decontamination and Waste Treatment Facility: Documentation of impact analysis for design alternatives presented in the Draft Environmental Impact Statement. (Lawrence Livermore National Lab., CA (USA); Radian Corp., Sacramento, CA (USA)). May 1988. Contract W-7405-ENG-48. 855p. NTIS, PC A99. Order Number DE88013820/JAW.

Lawrence Livermore National Laboratory (LLNL) is proposing to construct and operate a new Decontamination and Waste Treatment Facility (DWTF). The proposed DWTF would replace the existing Hazardous Waste Management (HWM) facilities at LLNL. The US Department of Energy (DOE) is preparing a Draft Environmental Impact Statement (DEIS) to assess the environmental consequences of the proposed DWTF and its alternatives. This report presents the assumptions, methodologies, and analyses used to estimate the waste flows, air emissions, ambient air quality impacts, and public health risks that are presented in the DEIS. Two DWTF design alternatives (Level I and Level II) have been designated as reasonable design alternatives considering available technologies, environmental regulations, and current and future LLNL waste generation. Both design alternatives would include new, separate radioactive and nonradioactive liquid waste treatment systems, a solidification unit, a new decontamination facility, storage and treatment facilities for reactive materials, a radioactive waste storage area, receiving and classification areas, and a uranium burn pan. The Level I design alternative would include a controlled-air incinerator system, while the Level II design alternative would include a rotary kiln incinerator system. 43 refs., 4 figs., 24 tabs.

46394 (UCRL—99231) The use of scans for impact studies of transportation packages. Mok, G.C.; Witte, M.C. (Lawrence Livermore National Lab., CA (USA)). 24 Jun 1988. Contract W-7405-ENG-48. 8p. (CONF-880631—35). NTIS, PC A02/MF A01; 3; GPO Dep. Order Number DE88014484/JAW.

From 29. annual meeting of the Institute of Nuclear Materials Management; Las Vegas, NV, USA (26 Jun 1988).

This paper presents the results of an impact study using the computer program SCANS (Shipping Cask ANalysis System), which was developed by Lawrence Livermore National Laboratory (LLNL) for the US Nuclear Regulatory Commission (NRC) and the Department of Energy (DOE) for structural analysis of transportation packages of radioactive materials. The program operates on IBM PC and compatible microcomputers. It has capabilities for other analysis such as heat transfer, pressure and thermal stress analysis. However, this study uses only the impact analysis capability, which includes a quasi-static and a dynamic analysis option. It is shown that the program produces reasonable results for a wide range of impact conditions. The results are in agreement with existing information on impact analysis and phenomenon. In view of its simplicity in modelling and convenience in usage, the SCANS program can be effectively used for confirmatory analysis, preliminary design study, and quick assessment of the need for detailed impact analysis. 2 refs., 7 figs., 2 tabs.

46395 (WHC-EP—0070) Long-term, low-temperature oxidation of PWR spent fuel: Interim transition report. Einziger, R.E.; Buchanan, H.C. (Westinghouse Hanford Co., Richland, WA (USA)). May 1988. Contract AC06-87RL10930. 84p. NTIS, PC A05/MF A01; 1; GPO Dep. Order Number DE88013497/JAW.

Since some of the fuel rods will be breached and eventually most of the cladding will corrode, exposing fuel, one factor influencing the ability of spent fuel to retain radionuclides is its oxidation state in the expected moist air atmosphere. Oxidation of the fuel could split the cladding, exposing additional fuel and changing the leaching characteristics. Thermodynamically, there is no reason why UO_2 should not oxidize completely to UO_3 at repository temperatures. The underlying uncertainty is the rate of oxidation. Extrapolation of higher temperature data indicates that insufficient oxidation to convert all of the fuel to U_3O_8 will occur during the first 10,000 years. However, lower oxidation states, such as U_4O_9 and U_3O_7, might form. To date, the tests have run between 3200 and 4100 hours out of a planned 16,000-hour duration. Some preliminary conclusions can be drawn: (1) Moisture content of the air has

no significant effect on oxidation rate, (2) the data have an uncertainty of 15 to 20%, which must be accounted for in the interpretation of single sample tests, and (3) below 175{degree}C, the oxidation rate is dependent on the particle size in the sample. The smaller particles oxidize more rapidly. 19 refs., 23 figs., 7 tabs.

46396 **(WHC-SA—0054) Measurement of plutonium isotopic content in waste drums: Preliminary work.** Westsik, G.A. (Westinghouse Hanford Co., Richland, WA (USA)). Oct 1987. Contract AC06-87RL10930. 8p. (CONF-871015—4). NTIS, PC A02/MF A01; 1; GPO Dep. Order Number DE88013667/JAW.

From 30. conference on analytical chemistry in energy technology; Knoxville, TN, USA (20 Oct 1987).

Plutonium-bearing material processed at the Plutonium Uranium Extraction (PUREX) and Plutonium Finishing Plants on the Hanford Site has, over the years, varied as to the plutonium isotopic composition. Until recently, this has not impacted the plutonium assay information required for solid waste generated at the processing plants. However, the Waste Isolation Pilot Plant (WIPP), to which the material is sent, requires new and more detailed information about the plutonium isotopic content of 208-liter waste drums. Consequently, a method is needed to determine the isotopic distribution of plutonium in waste drums to satisfy WIPP waste acceptance criteria. This document reports the results from a preliminary feasibility study wherein isotopic measurements were performed on waste drum contents while a final accountability assay was being performed. 2 refs., 4 tabs.

46397 **(WHC-SA—0075) Progress in Defense High-Level Waste disposal.** Wodrich, D.D.; Bracken, E.A. (Westinghouse Hanford Co., Richland, WA (USA); USDOE Richland Operations Office, WA). Feb 1988. Contract AC06-87RL10930. 17p. (CONF-880201—41). NTIS, PC A03/MF A01; 1; GPO Dep. Order Number DE88013660/JAW.

From Waste management '88: symposium on radioactive waste management; Tucson, AZ, USA (26 Feb 1988).

The US Department of Energy (DOE) is making good progress in its program to dispose of Defense High-Level Waste (DHLW) stored at the Savannah River Laboratory in South Carolina; Hanford Site in Washington; and Idaho National Engineering Laboratory in Idaho. The Defense Waste Processing Facility (DWPF) at Savannah River is more than 65% complete, the Hanford Site has issued its Environmental Impact Statement on disposal alternatives, and Idaho is developing disposal strategy. A decision has been made to dispose of DHLW in the civilian geologic repositories being developed as part of the Nuclear Waste Policy Act (NWPA), and the waste acceptance process has been defined. 5 refs., 5 figs., 1 tab.

46398 **(WHC-SA—0102) An introduction to technical issues important to geologic repository preclosure safety.** Babad, H.; Dukelow, J.S. Jr. (Westinghouse Hanford Co., Richland, WA (USA)). Feb 1988. Contract AC06-87RL10930. 10p. (CONF-880354—9). NTIS, PC A02/MF A01; 1; GPO Dep. Order Number DE88013581/JAW.

From Waste management '88; Tucson, AZ, USA (1 Mar 1988).

Preclosure safety assessment for construction, operation, caretaking, and decommissioning is required by the US Nuclear Regulatory Commission (NC) regulations as part of a license application for nuclear waste repositories. This paper will present a variety of design and safety analysis issues addressed as part of the preclosure safety analysis of nuclear waste repositories. The definition of the issues and suggested approaches to resolving the issues will be presented. These technical issues arose during the process of defining site-specific issue resolution strategies related to design and preclosure safety (Key Issue 2) in the Office of Geologic Repositories Issues Hierarchy. These issue resolution strategies are described in the Basalt Waste Isolation Project (BWIP) Site Characterization Plan. Participation in the US Department of Energy (DOE) Preclosure Risk Assessment Methodology (PRAM) Working Group has also helped to define the open technical issues. 9 refs.

46399 **(WHC-SA—0246) Update on the Hanford Waste Vitrification Plant technical developments.** Scott, J.L.; Wolfe, B.A.; Allen, C.R.; Bates, S.O. (Westinghouse Hanford Co., Richland, WA (USA)). Jan 1988. Contract AC06-87RL10930. 8p. (CONF-880354—8). NTIS, PC A02/MF A01; 1; GPO Dep. Order Number DE88013582/JAW.

From Waste management '88; Tucson, AZ, USA (1 Mar 1988).

This paper presents a brief description of the HWVP Project and describes the progress made by the HWVP Project on key applied technology issues. The HWVP technology approach is to identify key HWVP waste-form qualification and design issues, identify sources of applicable vitrification technology, and maximize the use of existing DOE vitrification technology and design resources. The HWVP issues will be resolved through technology exchange, support from other Hanford Site waste-management programs, and a limited HWVP applied technology development effort. Using Defense Waste Processing Facility and West Valley Demonstration Project technology as a basis, the HWVP applied technology efforts have established a reference Hanford Site pretreated high-level waste feed, borosilicate glass, vitrification flowsheet, and a data base to support detailed design. Key feed and glass properties as well as vitrification process parameters have been characterized. A preliminary HWVP waste form description and form qualification planning document have been prepared. 3 refs., 2 tabs.

46400 **Continuum model for water movement in an unsaturated fractured rock mass.** Peters, R.R.; Klavetter, E.A. (Sandia National Labs., Albuquerque, NM (USA)). *Water Resources Research;* **24**: No. 3, 416-430(Mar 1988). Contract AC04-76DP00789.

The movement of fluids in a fractured, porous medium has been the subject of considerable study. This paper presents a continuum model that may be used to evaluate the isothermal movement of water in an unsaturated, fractured, porous medium under slowly changing conditions. This continuum model was developed for use in evaluating the unsaturated zone at the Yucca Mountain site as a potential repository for high-level nuclear waste. Thus its development has been influenced by the conditions thought to be present at Yucca Mountain. A macroscopic approach and a microscopic approach are used to develop a continuum model to evaluate water movement in a fractured rock mass. Both approaches assume that the pressure head in the fractures and the matrix are identical in a plane perpendicular to flow. Both approaches lead to a single-flow equation for a fractured rock mass. The two approaches are used to calculate unsaturated hydrologic properties, i.e., relative permeability and saturation as a function of pressure head, for several types of tuff underlying Yucca Mountain, using the best available hydrologic data for the matrix and the fractures. Rock mass properties calculated by both approaches are similar.

46401 **Performance assessments for regulatory compliance.** Foley, M.G.; Cole, C.R. (Pacific Northwest Lab., Richland, WA (USA)). *Transactions of the American Nuclear Society;* **55**: 81(1987). (CONF-8711195—).

From American Nuclear Society winter meeting; Los Angeles, CA, USA (15 Nov 1987).

Performance assessments will be used in support of waste management facility site selection, engineered component design, and licensing for construction, operation, and decommissioning. Regulatory standards and criteria require performance periods so long that predictive performance assessments provide the only means to demonstrate compliance. Current regulations require reasonable assurance that waste-containment facilities will protect public health and safety. Assurance is based on technical criteria and on an administrative judgment of the credibility and defensibility of the analyses. Experience is now clearly showing that the way performance-assessment analyses are planned, performed, documented, and communicated to decision makers and the public is as important as results of the analyses in achieving reasonable assurance.

46402 **Guidelines and precautions in collecting and analyzing for mixed wastes.** Hall, J.R.; Stagg, D.D.; Clark, S.L. *Transactions of the American Nuclear Society;* **55**: 87(1987). (CONF-8711195—).

From American Nuclear Society winter meeting; Los Angeles, CA, USA (15 Nov 1987).

Regulatory requirements mandated by the US Environmental Protection Agency (EPA) for the Resource Conservation and Recovery Act, the Superfund, and the EPA/US Nuclear Regulatory Commission guidance document have generated an increasing demand for hazardous materials analysis of radioactive contaminated samples (mixed waste). The analysis of these samples, which contain both radioactive and hazardous materials, using EPA methods requires that both the sample collection and the analytical analysis be performed using guidelines and precautions different from those normally used for radioanalytical work. The paper discusses the unique procedures, guidelines, and precautions one must use in collecting and analyzing mixed waste samples in order to achieve accurate and reliable results and reports the recent experience of International Technology (IT) Corporation in constructing and operating a mixed waste laboratory. It also describes the experience of IT personnel in collecting samples in the field.

46403 **Road to NRC's Center for Nuclear Waste Regulatory Analyses.** Bunting, J.O.; Wade, P.D. *Transactions of the American Nuclear Society;* **55**: 97-98(1987). (CONF-8711195—).

From American Nuclear Society winter meeting; Los Angeles, CA, USA (15 Nov 1987).

By the fall of 1987, the US Nuclear Regulatory Commission (NRC) expects to award a contract for a federally funded research and development center (FFRDC). The FFRDC will be entitled the Center for Nuclear Waste Regulatory Analyses and will provide long-term technical expertise to NRC in all major aspects of the high-level waste regulatory program. The center will also be one of only a few FFRDCs in the nation with a system engineering and integration role. The road to achieving this major milestone, however, has been a long and arduous one. Discussed in this paper are the background leading to the need for an FFRDC and some of the major challenges faced in developing the criteria and selecting the winner.

46404 **Systems engineering documents: lifting the fog.** Scully, L. (Los Alamos Technical Association, NM (USA)). *Transactions of the American Nuclear Society;* **55**: 98-99(1987). (CONF-8711195—).

From American Nuclear Society winter meeting; Los Angeles, CA, USA (15 Nov 1987).

There are many other reasons why a project of the importance of a nuclear waste repository must implement systems engineering techniques and produce more rigorous documentation than large projects in the past. First, while any single element of a repository employs reasonably simple technology, many of the elements interact extensively, which requires careful definition and quantification of their relationships. Second, many persons, agencies, and contractors are involved in this interrelated activities. Consequently, a large number of requirements must be identified, communicated to those responsible for meeting them, satisfied, and documented. Finally, the program extends over a long period of time, during which people and organizations will come and go. With a large, long-term project demanding the interaction of many people and tasks, clearly written documents must be generated to communicate with interested parties both inside and outside the project and to preserve continuity through changes in organizations and personnel, hence, the need for project plans, management plans, technical plans, implementing procedures, topical reports, requirements documents, regulatory reports. A few simple guidelines which can help to keep the documents readable and understandable are offered.

46405 **System engineering workstations - critical tool in addressing waste storage, transportation, or disposal.** Mar, B.W. (Univ. of Washington, Seattle (USA)). *Transactions of the American Nuclear Society;* **55**: 99-100(1987). (CONF-8711195—).

From American Nuclear Society winter meeting; Los Angeles, CA, USA (15 Nov 1987).

The ability to create, evaluate, operate, and manage waste storage, transportation, and disposal systems (WSTDSs) is greatly enhanced when automated tools are available to support the generation of the voluminous mass of documents and data associated with the system engineering of the program. A system engineering workstation is an optimized set of hardware and software that provides such automated tools to those performing system engineering functions. This paper explores the functions that need to be performed by a WSTDS system engineering workstation. While the latter stages of a major WSTDS may require a mainframe computer and specialized software systems, most of the required system engineering functions can be supported by a system engineering workstation consisting of a personnel computer and commercial software. These findings suggest system engineering workstations for WSTDS applications will cost less than $5000 per unit, and the payback on the investment can be realized in a few months. In most cases the major cost element is not the capital costs of hardware or software, but the cost to train or retrain the system engineers in the use of the workstation and to ensure that the system engineering functions are properly conducted.

46406 **High-level-waste records management system: the NRC pilot project.** Bender, A.; Altomare, P. *Transactions of the American Nuclear Society;* **55**: 100(1987). (CONF-8711195—).

From American Nuclear Society winter meeting; Los Angeles, CA, USA (15 Nov 1987).

The US Nuclear Regulatory Commission (NRC) and the US Dept. of Energy (DOE) have agreed to develop a licensing support system (LSS) to address the records management requirements created by the Nuclear Waste Policy Act (NWPA). The NRC is planning to conduct a negotiated rule making the modify 10CFR2, including rules governing discovery, so that parties to the licensing process will use a single information management system as a source for all licensing-related documents. The successful demonstration of the pilot project has resulted in an operational on-line record management system for NRC-related HLW documents. Both incoming and outgoing documents are being scanned and stored on a mainframe system and on an optical disk. At this writing the optical disk portion of the system is being tested to evaluate its potential use as a future archival and distribution medium for licensing records. Experience gained from this project is being shared with other government agencies that are in the process of using similar technologies to come to grips with the complex records management problem endemic to our information-based society.

46407 **Performance assessment in the repository design process.** Jardine, L.J.; Norman, N.A. *Transactions of the American Nuclear Society;* **55**: 100-101(1987). (CONF-8711195—).

From American Nuclear Society winter meeting; Los Angeles, CA, USA (15 Nov 1987).

In 1976 the US Office of Management and Budget directed through circular A109 that major US Dept. of Defense programs be conducted using a systems engineering process. This process is now being implemented by the US Dept. of Energy for the High-Level Nuclear Waste Management Program. A systems engineering process coupled with quantitative numerical performance assessments is being applied to Bechtel's design activities for the geologic repository project. Our systems engineering process involves an iterative approach in which the results of a design phase, be it conceptual, advanced conceptual, license application, the final procurement and construction design, or an as-built design are assessed and analyzed using performance assessment practices to determine if the assessment results or the dose consequences meet the basic waste management system mission requirements and also protect the public health and safety. The performance assessments aid in guiding the engineering design process, establishing realistic design requirements, enhancing the overall safety in the design, and verifying that the mission objectives can be met. This paper discusses the iterative performance assessment practices being developed and applied to Bechtel's geologic repository activities. Several illustrative examples are given to demonstrate the performance assessment process.

46408 System analysis approach to verification of site characterization parameters. Romine, D.T. *Transactions of the American Nuclear Society;* **55**: 101-103(1987). (CONF-8711195—).

From American Nuclear Society winter meeting; Los Angeles, CA, USA (15 Nov 1987).

Early in the transition of the Basalt Waste Isolation Project (BWIP) from a preliminary geologic investigation to a part of a major system acquisition program, the following project needs were recognized: (1) site-specific system functional requirements, i.e., the capabilities a deep geologic basalt system must provide to ensure long-term isolation of wastes, (2) complete list of design variables and site characteristics (information and data needs) that could affect system capabilities; and (3) relative importance, availability, and uncertainty of these information and data needs. The first project need was satisfied by a conventional functional analysis. The second was answered by a unique extension of that functional analysis. The results of these two efforts have been released in the BWIP System Functional Analysis (SFA) Document. The third need is presently under study. With the advent of a formalized issue resolution strategy (IRS) process as the basis for the BWIP site characterization program, a subset of the SFA information and data needs was used to verify (a) that no significant variable was omitted from consideration in the IRS process, (b) the necessity of IRS site characterization parameters, and (c) the sufficiency of each issue-related set of IRS parameters to address that issue. An example of a SFA branch is discussed.

46409 Application of systems engineering to determine performance requirements for repository waste packages. Aitken, E.A.; Stimmell, G.L. (General Electric Co., San Jose, CA (USA)). *Transactions of the American Nuclear Society;* **55**: 103-104(1987). (CONF-8711195—).

From American Nuclear Society winter meeting; Los Angeles, CA, USA (15 Nov 1987).

The waste package for a nuclear waste repository in salt must contribute substantially to the performance objectives defined by the Salt Repository Project (SRP) general requirements document governing disposal of high-level waste. The waste package is one of the engineered barriers providing containment. In establishing the performance requirements for a project focused on design and fabrication of the waste package, the systems engineering methodology has been used to translate the hierarchy requirements for the repository system to specific performance requirements for design and fabrication of the waste package, a subsystem of the repository. This activity is ongoing and requires a methodology that provides traceability and is capable of iteration as baseline requirements are refined or changed. The purpose of this summary is to describe the methodology being used and the way it can be applied to similar activities in the nuclear industry.

46410 Allocation of performance to a disposal system. Voss, J.W.; Pentz, D.L. *Transactions of the American Nuclear Society;* **55**: 104-105(1987). (CONF-8711195—).

From American Nuclear Society winter meeting; Los Angeles, CA, USA (15 Nov 1987).

The US Dept. of Energy (DOE) is developing plans for the characterization of its candidate repository sites in salt, basalt, and tuff. These plans must be founded on detailed and integrated strategies that outline the data to be acquired, the analytic and numerical models to be developed, and the designs to be completed in order to determine if a repository can be shown to be suitable at each of the candidate sites. The strategies developed for site characterization must initially account for all performance requirements imposed on the disposal system. These requirements are substantially reflected within the standards of the Environmental Protection Agency (EPA; 40CFR191) and the implementing regulations of the Nuclear Regulatory Commission (NRC; 10CFR60). The strategies, in combination with the available geoscience and engineering information, must then establish the manner in which performance is to be allocated to subparts of the disposal system.

46411 Can melter system for the University of Missouri research reactor. Edwards, C.B.; Brugger, R.M.; Stevens, R.E. (Univ. of Missouri, Columbia (USA)). *Transactions of the American Nuclear Society;* **55**: 110(1987). (CONF-8711195—).

From American Nuclear Society winter meeting; Los Angeles, CA, USA (15 Nov 1987).

The University of Missouri Research Reactor (MURR), in its programs of research, education, and service, operates to support the needs of MURR staff, University of Missouri faculty, other colleges and universities, national laboratories, state and federal agencies, and industrial users. Programs in research and service include neutron activation analysis, radioisotope applications, materials testing, neutron scattering, and nuclear engineering. MURR operates at 10 MW of thermal power for more than 8000 h/yr at peak neutron fluxes of up to 6×10^{14} n/cm^2 x s^{-1}. MURR generates considerable volumes of low-level class A radioactive waste products. In particular, large volumes of low-level radioactive aluminum wastes are generated, and the Can Melter System (CMS) was developed to reduce the volume of this waste. The CMS has been in service at MURR since 1985. The CMS reduced the volume of aluminum by a factor of 40. Projected technician radioactive exposures are 1.068 person-rem/yr whole body and 2.607 person-rem/yr to the extremities. The exhaust emissions were filtered adequately with no releases, and radioactive contamination was restrained to the internal workings of the CMS stations, requiring minimal decontamination.

46412 Removal of contaminants from liquid waste by acid fractionation. McIntyre, C.V.; Ramer, R.J. *Transactions of the American Nuclear Society;* **55**: 110-112(1987). (CONF-8711195—).

From American Nuclear Society winter meeting; Los Angeles, CA, USA (15 Nov 1987).

The Idaho Chemical Processing Plant at the Idaho National Engineering Laboratory reprocesses nuclear fuel for the US Department of Energy. A low-level liquid waste stream is then concentrated in the process equipment waste (PEW) evaporator. The product is treated as high-level waste and is solidified in a fluidized bed calciner. The very low level distillate is directed to a percolation pond. Due to proposed plant expansions and increased throughput, the evaporator alone may not be capable of satisfying restrictions on radionuclide and chemical releases to the environment. Therefore, an alternate cleanup and disposal system is planned. The recommended method is acid fractionation of the PEW condensate followed by filtration and atmospheric disposal of the resulting distillate. Acid fractionation is a viable option for removing contaminants from PEW condensate and for reducing the volume of radioactive liquid waste. Nonvolatile radionuclide concentrations are decreased by a factor of ~ 100,000. Only chloride and organic compounds are present to any significant extent in the distillate.

46413 Studies involving proposed waste disposal facilities in Turkey. Ualu, I.; Fields, D.E.; Yalcintas, M.G. (Oak Ridge National Lab., TN (USA)). *Transactions of the American Nuclear Society;* **55**: 114-115(1987). (CONF-8711195—).

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The Turkish government is in the process of planning two nuclear reactors in Turkey. The Turkish Atomic Energy Authority has been given the task of developing plans for improved control of low-level wastes (LLW) in Turkey. Principal sources of radioactive wastes are hospitals, research institutions, biological research centers, universities, industries, and two research reactors in Turkey. These wastes will be treated in a pilot water treatment facility located in Cekmece Nuclear Research and Training Center, Istanbul. In this temporary waste disposal facility, the wastes will be stored in 200-l concrete containers until the establishment of the permanent waste disposal sites in Turkey in 1990. The PRESTO-II (prediction of radiation effects from shallow trench operations) computer code has been applied for the general probable sites for LLW disposal in Turkey. The model is intended to serve as a non-site-specific screening model for assessing radionuclide transport, ensuring exposure, and health impacts to a static local population for a chosen time period, following the end of the disposal operation. The methodology that this code takes into consideration is versatile and explicitly considers infiltration and percolation of surface water into the trench, leaching of radionuclides, vertical and horizontal transport of radionuclides, and use of this contaminated ground water for farming, irrigation, and ingestion.

46414 Radiological assessment of the consequences of the disposal of high-level radioactive waste in subseabed sediments. de Marsily, G.; Behrendt, V.; Ensminger, D.A.; Flebus, C.; Hutchinson, B.L.; Kane, P.; Karpf, A.; Klett, R.D.; Mobbs, S.; Poulin, M.; Stanners, D.A.; Wuschke, D. (Paris School of Mines (France)). *Transactions of the American Nuclear Society;* **55**: 128-129(1987). (CONF-8711195—).

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The radiological assessment of the seabed option consists in estimating the detriment to man and to the environment that could result from the disposal of high-level waste (HLW) within the seabed sediments in deep oceans. The assessment is made for the high-level waste (vitrified glass) produced by the reprocessing of 10^6 tons of heavy metal from spent fuel, which represents the amount of waste generated by 3333 reactor-yr of 900-MW(electric) reactors, i.e., 3000 GW(electric) x yr. The disposal option considered is to use 14,667 steel penetrators, each of them containing five canisters of HLW glass (0.15 m^3 each). These penetrators would reach a depth of 50 m in the sediments and would be placed at an average distance of 180 m from each other, requiring a disposal area on the order of 22 x 22 km. Two such potential disposal areas in the Atlantic Ocean were studied, Great Meteor East (GME) and South Nares Abyssal Plains (SNAP). A special ship design is proposed to minimize transportation accidents. Approximately 100 shipments would be necessary to dispose of the proposed amount of waste. The results of this radiological assessment seem to show that the disposal of HLW in subseabed sediments is radiologically a very acceptable option.

46415 Diffusion of Europium in deep-sea sediments. Fong, B.B.; Chatt, A. (Dalhousie Univ. (Canada)). *Transactions of the American Nuclear Society;* **55**: 129-130(1987). (CONF-8711195—).

From American Nuclear Society winter meeting; Los Angeles, CA, USA (15 Nov 1987).

Since the overall concept of disposal of high-level radioactive waste in subseabed sediments in the United States was first described by Bishop and Hollister, several countries have become involved in evaluating various aspects of such an option. Under an accidental scenario, the waste form could come in contact with interstitial pore water and eventually dissolve in it, thereby releasing the radionuclides. Although the engineered barriers such as the waste form, waste canister, and backfill materials are envisaged to offer resistance to some extent to this process, much of the long-term safety depends on the ability of the sediment to provide a natural geochemical barrier to the migration of the radionuclides from subseabed repository to biosphere. While methods are being developed to characterize sediments and physicochemical forms of radionuclides and their chemical analogues in this and other laboratories, it is also necessary to determine diffusion coefficients to assess their migration potentials. In the present study, the effective diffusion coefficients (D/sub eff/) of Eu(III) in two types of sediment have been measured.

46416 Waste dissolution with chemical reaction, diffusion, and advection. Chambre, P.L.; Kang, C.H.; Lee, W.W.L.; Pigford, T.H. (Univ. of California, Berkeley (USA)). *Transactions of the American Nuclear Society;* **55**: 130-131(1987). (CONF-8711195—).

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The authors analytic equations predict the rate at which a low-solubility species in a waste solid dissolves in ground water, conservatively assuming that each dissolved species is at its saturation concentration in the liquid at the surface of the waste solid. Then considered was the effect of a chemical-reaction-rate boundary condition, using empirical rate data determined from laboratory leach tests, and provided a means of calculating the time-dependent concentration of dissolved species near the waste surface and the time-dependent diffusive mass transfer into the surrounding rock. Surface-liquid concentrations of low-solubility species from borosilicate glass waste and spent fuel soon reach values close to saturation. The present paper extends the mass-transfer analysis to include the effect of advective transport in predicting the steady-state dissolution rate, with a chemical-reaction-rate boundary condition at the surface of a waste form of arbitrary shape. This new theory provides an analytic means of predicting the ground water velocities at which dissolution rate in a geological environment will be governed entirely by the chemical reaction rate.

46417 Release rates from waste packages in a salt repository. Chambre, P.L.; Hwang, Y.; Lee, W.W.L.; Pigford, T.H. (Univ. of California, Berkeley (USA)). *Transactions of the American Nuclear Society;* **55**: 131-132(1987). (CONF-8711195—).

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The authors previously predicted very low thermally induced brine migration velocity in a salt repository after the salt has consolidated against the waste package - so low that radionuclide release into the consolidated salt is expected to occur largely by molecular diffusion of species in brine in the salt grain boundaries. In this paper they present estimates of radionuclide release rates from waste packages into salt. This analysis shows that for the parameter values selected here, and for containment times of > 300 yr, release rates from individual waste packages in salt can meet the US Nuclear Regulatory Commission's (NRC's) performance objective for the engineered barrier system. If the container fails shortly after emplacement, the release rate for ^{137}Cs is exceeded for up to 300 yr.

46418 Pressure-induced brine migration in consolidated salt in a repository. Hwang, Y.; Chambre, P.L.; Lee, W.W.L.; Pigford, T.H. (Univ. of California, Berkeley (USA)). *Transactions of the American Nuclear Society;* **55**: 132-133(1987). (CONF-8711195—).

From American Nuclear Society winter meeting; Los Angeles, CA, USA (15 Nov 1987).

Within a few years after the emplacement of waste packages in a geological repository of nuclear waste in salt, salt creep is expected to close the air gap between a waste container and the borehole wall. In this paper an analysis is presented of brine migration completely inside consolidated salt, considered here to be a thermoelastic, porous rock.

46419 Pressure-induced brine migration into an open borehole in a salt repository. Hwang, Y.; Chambre, P.L.; Lee, W.W.L.; Pigford, T.H. (Univ. of California, Berkeley (USA)). *Transactions of the American Nuclear Society;* **55**: 133-134(1987). (CONF-8711195—).

From American Nuclear Society winter meeting; Los Angeles, CA, USA (15 Nov 1987).

In the Environmental Assessment for a potential nuclear waste repository in salt, estimates of release rates of radionuclides from the engineered barrier system were made by multiplying the brine flow rate into an assumed open borehole at 300 yr by the solubilities of radioelements in the waste packages. The borehole was conservatively assumed to remain open at atmospheric pressure for hundreds and thousands of years. Brine was assumed to migrate into the borehole at a rate given by the Jenks equation for temperature-gradient induced movement of brine inclusions within individual salt crystals. However, it is now recognized that inclusions that reach grain boundaries are likely to move along grain boundaries under the influence of a pressure gradient, along with brine originally present in the grain boundaries. In this paper estimates are presented of the rate of brine accumulation in an assumed open borehole, based on grain-boundary migration theory.

46420 Time-dependent nuclide transport through backfill into a fracture. Kang, C.H.; Chambre, P.L.; Lee, W.W.L.; Pigford, T.H. (Univ. of California, Berkeley (USA)). *Transactions of the American Nuclear Society;* **55**: 134-136(1987). (CONF-8711195—).

From American Nuclear Society winter meeting; Los Angeles, CA, USA (15 Nov 1987).

Fractures (fissures) in the emplacement rock of a geological repository of nuclear waste may intersect boreholes for waste packages, providing conductive pathways for hydrogeological transport of radionuclides. A previous study of transport through backfill into a fissure considered only steady-state transport of a stable species. The US regulatory framework for geological disposal is for much shorter time scales and requires calculation of time-dependent

radionuclide transport into fractures. In this paper a transient analysis is presented of radionuclide transport through backfill into a fissure.

46421 **Effect of ground water flow rate on the liquid-surface concentration.** Zavoshy, S.J. *Transactions of the American Nuclear Society;* 55: 136-137(1987). (CONF-8711195—).

From American Nuclear Society winter meeting; Los Angeles, CA, USA (15 Nov 1987).

In a previous analysis, the author considered mass transfer due to molecular diffusion of a dissolved species in the liquid phase of a water-saturated porous rock in the absence of ground water convection. In this paper, the effect of ground water flow on the liquid-surface concentration and the mass transfer rate is analyzed.

46422 **Application of microwave energy for solidification of TRU waste.** Petersen, R.D.; Johnson, A.J.; Swanson, S.D. *Transactions of the American Nuclear Society;* 55: 143-145(1987). (CONF-8711195—).

From American Nuclear Society winter meeting; Los Angeles, CA, USA (15 Nov 1987).

The application of microwave energy for in-container solidification of simulated transuranic (TRU)-contaminated precipitation sludges was studied. Preliminary results indicate that volume reductions of 80% are achievable by the continuous feeding of dried sludge into a waste container while applying microwave energy. An economic evaluation was completed showing that volume and weight reductions of up to 87% more are achievable than with an immobilization process currently in use on wet sludge.

46423 **Department of Energy's approach to managing mixed waste.** Eyman, L.D.; Sharples, F.E. (Oak Ridge National Lab., TN (USA)). *Transactions of the American Nuclear Society;* 55: 233-234(1987). (CONF-8711195—).

From American Nuclear Society winter meeting; Los Angeles, CA, USA (15 Nov 1987).

Until recently, the Dept. of Energy's (DOE's) management of its radioactive wastes was self-regulated under the authority of the Atomic Energy Act. In the last 2 yr, however, mixed low-level radioactive wastes were brought under hazardous waste regulation. In addition, on May 1, 1987, the DOE issued a final rule that subjects any nonradioactive hazardous components in radioactive wastes streams, including high-level and transuranic wastes, to additional regulation under the Resource Conservation and Recovery Act (RCRA). Many DOE wastes contain RCRA-regulated constituents, such as halogenated organic solvents, degreasers, and heavy metals. Such wastes are now considered to be mixed waste, and this change gives the Environmental Protection Agency (EPA) jurisdiction to impose a great many new requirements on DOE's radioactive waste management operations. All DOE mixed waste storage and disposal sites must now have RCRA permits and meet RCRA's technical requirements. As a result of these changes, DOE has had to formulate an entirely new approach to waste management, which has involved the establishment of new philosophies, programs, and procedures. This paper describes the new integrated approach for the management of hazardous and mixed wastes at DOE installations. The discussion includes waste minimization, RCRA-permitted storage, development of treatment and disposal options, and technology demonstration.

46424 **Hanford grout disposal program - an environmentally sound alternative.** Bergman, T.B.; Allison, J.M. *Transactions of the American Nuclear Society;* 55: 234-236(1987). (CONF-8711195—).

From American Nuclear Society winter meeting; Los Angeles, CA, USA (15 Nov 1987).

The Hanford Grout Disposal Program (HGDP) is a comprehensive, integrated program to develop technology and facilities for the disposal of ~ 3.0 x 10^6 m^3 (80 million gal) of the low-level fraction of liquid radioactive tank wastes at the Hanford site in southeastern Washington state. Environmentally sound disposal via long-term protection of the public and the environment is the principal goal of the HGDP. To accomplish this goal, several criteria have been established that guide technology and facility development activities. The key criteria are discussed. To meet the challenges posed by disposal of these wastes, the HGDP is developing a waste form using grout-forming materials, such as blast furnace slag, fly ash, clays, and Portland cement for solidification and immobilization of both the radioactive and hazardous chemical constituents. In addition to development of a final waste form, the HGDP is also developing a unique disposal system to assure long-term protection of the public and the environment. Disposal of a low-level nonhazardous waste will be initiated, as a demonstration of the disposal system concept, in June 1988. Disposal of higher activity hazardous wastes is scheduled to begin in October 1989.

46425 **Hanford grout: predicting long-term performance.** Sewart, G.H.; Mitchell, D.H.; Treat, R.L.; McMakin, A.H. (Pacific Northwest Lab., Richland, WA (USA)). *Transactions of the American Nuclear Society;* 55: 236(1987). (CONF-8711195—).

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Grouted disposal is being planned for the low-level portion of liquid radioactive wastes at the Hanford site in Washington state. The performance of the disposal system must be such that it will protect people and the environment for thousands of years after disposal. To predict whether a specific grout disposal system will comply with existing and foreseen regulations, a performance assessment (PA) is performed. Long-term PAs are conducted for a range of performance conditions. Performance assessment is an inexact science. Quantifying projected impacts is especially difficult when only scant data exist on the behavior of certain components of the disposal system over thousands of years. To develop defensible results, we are honing the models and obtaining experimental data. The combination of engineered features and PA refinements is being used to ensure that Hanford grout will meet its principal goal: to protect people and the environment in the future.

46426 **Plasma arc stabilization of hazardous mixed wastes.** Eschenbach, R.C.; Boomer, K.D. *Transactions of the American Nuclear Society;* 55: 237(1987). (CONF-8711195—).

From American Nuclear Society winter meeting; Los Angeles, CA, USA (15 Nov 1987).

Many radioactive and toxic wastes come in forms awkward to deal with. Gases and liquids can be moved around readily. Bulky solids such as fabrics have a large volume per unit of radioactivity or toxicity, however, and the volume is difficult to reduce. This paper reports work with a transferred plasma arc, demonstrating effective volume reduction of mixed simulated radioactive wastes (containing metals, glass, plastics, rubber, filter elements, etc.). Initial tests were done with a 75-kW lab-scale plasma system at Retech, and demonstration tests with gallon pails filled with simulated wastes were carried out using a titanium production furnace at Oregon Metallurgical Corporation. These tests showed a 20-fold reduction in volume of the simulated wastes and a 1.8-fold reduction in weight. It is clear that it would be desirable to add oxygen or air to the furnace gas to convert the hydrocarbons to carbon dioxide and water rather than soot, carbon monoxide, and hydrogen. Shredding could be used to reduce the magnitude of swings in volatilization rate, thus markedly reducing the frequency of arc-outs. Future work is planned to determine the effectiveness of adding oxidants for reducing the amount of sooting.

46427 **Controlled air incineration of hazardous chemical and mixed waste at Los Alamos.** Borduin, L.C.; Hutchins, D.A.; Vavruska, J.J.; Warner, C.L. (Los Alamos National Lab., NM (USA)). *Transactions of the American Nuclear Society;* 55: 237-238(1987). (CONF-8711195—).

From American Nuclear Society winter meeting; Los Angeles, CA, USA (15 Nov 1987).

The Los Alamos National Laboratory (LANL) Controlled Air Incineration (CAI) system, originally developed for transuranic (TRU) waste volume reduction studies, is currently being qualified for hazardous chemical and mixed waste treatment under provisions of the Resource Conservation and Recovery Act (RCRA). The objective is to obtain a permanent RCRA Part B permit for thermal disposal of hazardous and mixed wastes generated by LANL. Constructed in the mid-1970s as a demonstration project for incineration of TRU solid wastes, the CAI process was substantially modified and tested in 1980-1983 for acceptance of both liquid and solid hazardous chemicals. Successful demonstration of TRU solid waste

processing objectives in 1979 and later chemical waste incineration studies have been documented in several publications. In 1984, the LANL CAI became the first US Dept. of Energy (DOE) incinerator to be permitted for polychlorinated biphenyl disposal under the Toxic Substances Control Act. Following establishment of Environmental Protection Agency (EPA) jurisdiction over DOE chemical waste management in 1984, LANL sought and was granted interim status for the CAI and applied for a trial burn permit in the overall laboratory RCRA Part B application. A trial burn and final report have been completed; results have been submitted to EPA and the New Mexico Environmental Improvement Division. This paper provides an overview of trial burn planning and results together with the operational status of LANL's CAI.

46428 **Using solvent extraction to process nitrate anion exchange column effluents.** Yarbro, S.L. (Los Alamos National Lab., NM (USA)). *Transactions of the American Nuclear Society;* **55**: 245-246(1987). (CONF-8711195—).

From American Nuclear Society winter meeting; Los Angeles, CA, USA (15 Nov 1987).

At the Los Alamos National Laboratory (LANL) plutonium facility, nitrate anion exchange is routinely used to purify impure plutonium scrap; however, the anion exchange process generates large volumes of low-activity aqueous waste. Unfortunately, the evaporation/cementation process has several disadvantages. First, valuable materials, like plutonium, cannot be recovered and have to be placed in burial sites. Since the cost of producing plutonium is increasing and environmental restrictions are tighter, it is desirable to minimize the amount of transuranic (TRU) materials sent to burial. Also, the waste treatment capacity is undersized to handle the anion exchange capacity currently available. However, with the development of octyl(phenyl)-N,N-diisobutylcarbamoyl-methylphosphine oxide (CMPO) and a new centrifugal mixer-settler, it is possible to use solvent extraction as a means of recovering $^{+}$III, $^{+}$IV, and $^{+}$VI actinides from anion exchange waste streams. Extracting the actinides from the column waste streams reduces the activity of the solution to the level that allows it to be discharged directly to the waste handling facility, reducing the load on the evaporation/cementation processes and decreasing the volume of TRU waste generated. The objective of this study was to evaluate CMPO and the centrifugal mixer-settlers and then design a flow sheet and a set of centrifugal contacting equipment that would remove actinides from a concentrated nitric acid waste stream.

46429 **Low-temperature fluorination of actinides.** Avens, L.R.; Eller, P.G. (Los Alamos National Lab., NM (USA)). *Transactions of the American Nuclear Society;* **55**: 246-247(1987). (CONF-8711195—).

From American Nuclear Society winter meeting; Los Angeles, CA, USA (15 Nov 1987).

Los Alamos National Laboratory is developing next-generation plutonium process technology based on low-temperature fluorination techniques. This technology promises higher recovery with fewer processing steps compared to conventional recovery operations. An added advantage of low-temperature fluorination is reduced process waste. The 1984 discovery that oxygen fluorides would fluorinate plutonium compounds to volatile plutonium hexafluoride at or below room temperature led to a program to apply this result. High-temperature fluoride volatility processing (FVP) was studied at Argonne National Laboratory and Rocky Flats Plant in the 1960s and 1970s. The use of oxygen fluorides at room temperature would obviate several of the major problems encountered in former FVP work. Another new processing technology, superacid dissolution, can be used to rapidly dissolve and convert extremely intractable actinide-containing substrates to a fluoride matrix. Anhydrous hydrogen-fluoride/antimony-pentafluoride mixtures have been shown to have excellent dissolution properties. Dissolution of substrates in superacids followed by solvent removal (distillation) and thermal decomposition of hexafluoroantimonate products would give a reactive fluoride matrix ready for purification. Plans call for 200-g batch scale demonstration runs in fiscal year 1987 prior to full-scale deployment.

46430 **Integrated pyrochemical system for plutonium recovery.** Williams, J.D.; Bowersox, D.F.; Christensen, D.C. (Los Alamos National Lab., NM (USA)). *Transactions of the American Nuclear Society;* **55**: 248(1987). (CONF-8711195—).

From American Nuclear Society winter meeting; Los Angeles, CA, USA (15 Nov 1987).

Los Alamos National Laboratory currently has a vigorous pyrochemical research, development, and demonstration program, part of which is aimed at ultimately integrating the steps currently used for the recovery of metallic plutonium into a single cell. Although still in the conceptual stage, this unit operation will combine the reduction of the plutonium oxide to metal, the extraction of americium, and the electrochemical purification of the plutonium metal into a single piece of equipment. Peripheral reagent regeneration and recycle will be incorporated into the process to reduce residue and waste generation. Additional benefits are anticipated in the area of enhanced accountability.

46431 **Electrochemical investigation into the mechanism of plutonium reduction in electrorefining.** McCurry, L.E.; Moy, G.M.M. (Los Alamos National Lab., NM (USA)). *Transactions of the American Nuclear Society;* **55**: 248-250(1987). (CONF-8711195—).

From American Nuclear Society winter meeting; Los Angeles, CA, USA (15 Nov 1987).

Currently impure plutonium metal is purified at Los Alamos National Laboratory by a molten salt electrorefining process. Electrorefining is an effective method for producing high-purity plutonium metal (> 99.95%). In general this process involves the oxidation of impure plutonium metal from a molten plutonium anode or a solvent metal/plutonium anode, transport of plutonium ions through a molten salt electrolyte, and reduction of the plutonium ions at a tungsten cathode to pure plutonium metal. Purification of the plutonium metal from impurities is based on the difference in free energies of formation between the various metallic impurities associated with plutonium. To obtain a better understanding of the overall electrorefining process and its inefficiencies, an electrochemical investigation into the mechanism for plutonium reduction in a typical electrorefining environment was undertaken. Cyclic voltammetry was selected as the method for determining the electrode mechanism for plutonium reduction at tungsten electrodes. In addition to the standard electrorefining melt (equimolar NaCl-KCl), additional melts that were being investigated in our solvent anode work were also investigated. With insight gained from this investigation, it was hoped that a better selection of electrorefining operating parameters could be obtained.

46432 **Aqueous methods for recovery of plutonium from pyrochemical residues.** Muscatello, A.C.; Killion, M.E. *Transactions of the American Nuclear Society;* **55**: 250(1987). (CONF-8711195—).

From American Nuclear Society winter meeting; Los Angeles, CA, USA (15 Nov 1987).

Salt residues generated during such pyrochemical processing of plutonium as direct oxide reduction (DOR), electrorefining (ER), and molten salt extraction sometimes contain more plutonium than the economic discard limit, and the plutonium must be recovered. Consequently, the authors have been studying aqueous methods for recovering the plutonium and producing discardable wastes. Most of the work has been the investigation of chloride anion exchange recovery with some interest in leaching and precipitation techniques.

46433 **Sensitivity/uncertainty techniques in high-level nuclear waste isolation.** Harper, W.V. *Transactions of the American Nuclear Society;* **55**: 307-308(1987). (CONF-8711195—).

From American Nuclear Society winter meeting; Los Angeles, CA, USA (15 Nov 1987).

This paper gives a brief overview of the US Nuclear Regulatory Commission (NRC) and Environmental Protection Agency (EPA) regulatory criteria that must be satisfied before a high-level nuclear waste (HLW) repository can be licensed. From this the important role of sensitivity/uncertainty methods can be seen. A review of the current state of the art of the major methods is given in this paper that includes major recent developments.

46434 Uncertainties in performance assessments of high-level waste repositories. Cranwell, R.M. (Sandia National Lab., Albuquerque, NM (USA)). *Transactions of the American Nuclear Society;* 55: 308-309(1987). (CONF-8711195—).

From American Nuclear Society winter meeting; Los Angeles, CA, USA (15 Nov 1987).

Federal regulations governing repositories for high-level radioactive wastes (HLW) require an assessment of their performance over thousands of years. Predictions of the performance of these repositories will inevitably include uncertainties. These uncertainties come from a variety of sources, some of which are quantifiable and others which are not. Furthermore, regulations require that these uncertainties be incorporated into the performance assessment. This paper discusses these uncertainties and outlines approaches for their treatment. Emphasis is placed on those uncertainties that are quantifiable.

46435 Modeling inputs to computer models used in risk assessment. Iman, R.L. (Sandia National Lab., Albuquerque, NM (USA)). *Transactions of the American Nuclear Society;* 55: 309-310(1987). (CONF-8711195—).

From American Nuclear Society winter meeting; Los Angeles, CA, USA (15 Nov 1987).

Computer models for various risk assessment applications are closely scrutinized both from the standpoint of questioning the correctness of the underlying mathematical model with respect to the process it is attempting to model and from the standpoint of verifying that the computer model correctly implements the underlying mathematical model. A process that receives less scrutiny, but is nonetheless of equal importance, concerns the individual and joint modeling of the inputs. This modeling effort clearly has a great impact on the credibility of results. Model characteristics are reviewed in this paper that have a direct bearing on the model input process and reasons are given for using probabilities-based modeling with the inputs. The authors also present ways to model distributions for individual inputs and multivariate input structures when dependence and other constraints may be present.

46436 ADGEN: an automated adjoint code generator for large-scale sensitivity analysis. Pin, F.G.; Oblow, E.M.; Horwedel, J.E.; Lucius, J.L. (Oak Ridge National Lab., TN (USA)). *Transactions of the American Nuclear Society;* 55: 311(1987). (CONF-8711195—).

From American Nuclear Society winter meeting; Los Angeles, CA, USA (15 Nov 1987).

Sensitivity analysis is an established methodology used by researchers in almost every field to gain essential insight into design and modeling studies and performance assessments of complex systems. Statistical methods and perturbation analysis have traditionally been used to perform sensitivity analyses. When applied to large-scale studies (e.g., nuclear reactor design, reactor safety, radioactive waste isolation, etc.), these conventional methods have serious drawbacks: not only is their cost prohibitive, but they generally cannot handle all parameters involved in a study. Deterministic methods, on the other hand, such as the adjoint formulation, allow systematic and quantitative screening of the parameter space, thus providing all the information necessary to perform a complete sensitivity analysis including the inverse problem. These methods, however, have not enjoyed the widespread use they deserve, mainly because of the large initial analytical investment they require (e.g., to calculate the large number of derivatives necessary to set up the adjoint equations). This paper describes a new automated system, named ADGEN, which makes use of the strengths of computer calculus to automate the costly and time-consuming calculation of derivatives in FORTRAN computer codes and automatically generate adjoint solutions of computer codes.

46437 Deterministic uncertainty analysis. Worley, B.A. (Oak Ridge National Lab., TN (USA)). *Transactions of the American Nuclear Society;* 55: 312-313(1987). (CONF-8711195—).

From American Nuclear Society winter meeting; Los Angeles, CA, USA (15 Nov 1987).

Uncertainties of computer results are of primary interest in applications such as high-level waste (HLW) repository performance assessment in which experimental validation is not possible or practical. Because of the complicated nature of the computational structure of large computer models and because of the large number of input and data parameters associated with such models, to date almost all uncertainty analysis of computer results has been performed using a statistical approach. The purpose of this work is to present an alternate deterministic approach for calculating uncertainties that has the potential to significantly reduce the number of computer runs required for conventional statistical analysis.

46438 Hydrogen control in the handling, shipping, and storage of wet radioactive waste. Henrie, J.O.; Flesher, D.J. (Rockwell Hanford Operations, P.O. Box 800, 2E/2700E/A206, Richland, WA (US)). pp 636-646 of Influence of radiation on material properties: ASTM 13th international symposium (Part II). Garner, F.A.; Henager, C.H.; Igata, N. Philadelphia, PA; ASTM (1987). (CONF-860605—).

From 13. international symposium on the effects of radiation on materials; Seattle, WA, USA (23 Jun 1986).

Under development with the Department of Energy, Rockwell Hanford Operations (Rockwell) conducted a series of studies related to Three Mile Island (TMI) post loss of coolant accident (LOCA) waste handling safety. The key factor in these studies was the control of radiolytic gases, specifically hydrogen and oxygen. Success was achieved in the prediction of gas generation rates and in the development and application of gas control technologies. That success led to the publication of a "lessons learned" document, providing (1) a step-by-step guide in evaluating potential radiolysis hazards in waste storage and shipment activities and (2) a set of corrective options for preventing or controlling the hazards. The evaluation steps developed in the document are outlined in a functional logic diagram. Several procedures are described which provide safe and effective controls for hydrogen and oxygen levels in containers scheduled for shipment or interim storage. A method oia providing to pre-evaluate each control option and select the most cost effective procedure for each case.

0530 Environmental Aspects

REFER ALSO TO CITATION(S) 46334, 46335, 46336, 46337, 46338, 46339, 46340, 46341, 46342, 46343, 46344, 46345, 46346, 46347, 46348, 46349, 46350, 46351, 46352, 46353, 46354, 46355, 46356, 46357, 46358, 46361, 46362, 46363, 46365, 46368, 46369, 46370, 46372, 46373, 46379, 46384, 46385, 46386, 46393, 46394, 46395, 46396, 46397, 46398, 46399, 46442, 46443, 46652, 46653, 46655

46439 (MLM—3492) Environmental monitoring at Mound: 1987 report. Carfagno, D.G.; Farmer, B.M. (Monsanto Research Corp., Miamisburg, OH (USA). Mound). 25 Apr 1988. Contract AC04-76DP00053. 50p. NTIS, PC A03/MF A01; 1; GPO Dep. Order Number DE88013797/JAW.

The local environment around Mound as monitored primarily for tritium and plutonium-238. The results are reported for 1987. Environmental media analyzed included air, water, vegetation, food-stuffs, and sediment. The average concentrations of plutonium 238 and tritium were within the DOE interim air and water Derived Concentration Guides (DCG) for these radionuclides. The average incremental concentrations of plutonium-238 and tritium oxide in air measured at all offsite locations during 1987 were 4.6 x 10^{-18} μCi/mL and 12.9 x 10^{-12} μCi/mL, respectively. These correspond to 0.02% and 0.01%, respectively, of the DOE DCGs for uncontrolled areas. The average incremental concentration of plutonium-238 measured at all locations in the Great Miami River during 1987 was 1.4 x 10/sup - 12/ μCi/mL which is 0.0004% of the DOE DCG. The average incremental concentration of tritium measured at all locations in the Great Miami River during 1987 was 0.07 x 10^{-6} μCi/mL which is 0.004% of the DOE DCG. The dose equivalent estimates for the average air, water, and foodstuff concentrations indicate that the levels are 1% of the DOE standard of 100 mrem. 23 refs., 5 figs., 34 tabs.

46440 (WINCO—1055) ICPP [Idaho Chemical Processing Plant] environmental monitoring report, CY-1987. Krivanek, K.R. (Westinghouse Idaho Nuclear Co., Inc., Idaho Falls (USA)). Jun 1988. Contract AC07-84ID12435. 43p. NTIS, PC A03/MF A01; 1; GPO Dep. Order Number DE88015061/JAW.

Summarized in this report are the data collected through Environmental Monitoring programs conducted at the Idaho Chemi-

cal Processing Plant (ICPP). This project summarizes the volumes and activity released from ICPP stacks and liquid release points, a graphic representation of cumulative airborne releases, and cumulative liquid releases for the year. The graphs allow a comparison to be made of waste volume and activity released for the year. During 1987 1.19 E+03 curies of radionuclides (excluding krypton) were released from airborne and liquid emission points at the ICPP operations. Airborne releases to the atmosphere contributed 9.5 E+02 curies and liquid effluent released to the Percolation Pond contributed 2.4 E+02 curies. 27 figs., 14 tabs.

46441 **Effluent dispersion model.** Sjoden, G.E. *Transactions of the American Nuclear Society;* **55**: 79-80(1987). (CONF-8711195—).

From American Nuclear Society winter meeting; Los Angeles, CA, USA (15 Nov 1987).

Regulations regarding the releases of radioactive effluents to the environment require strict monitoring, control, and documentation. At the Idaho Chemical Processing Plant operated by the Westinghouse Idaho Nuclear Company, a method was required to predict the ground concentrations of radionuclides released from nuclear fuel reprocessing operations ongoing at the plant. This need led to the development of the STACK effluent dispersion computer model. The STACK model (sample transport atmospheric computer code) is used to locate sampling areas where effluent concentrations are the greatest and predict those concentrations based on amounts released from the stack. Environmental sampling teams were dispatched to those locations to gather environmental samples for analysis and verification. This paper outlines the application of the STACK model to industrial-scale effluent dispersion scenarios, and discuss results from efforts to benchmark the model's accuracy.

0540 Health And Safety

REFER ALSO TO CITATION(S) 46552, 46666, 46674, 47387

46442 **(DOE/EA—0343) Remedial action at the Green River uranium mill tailings site, Green River, Utah: Environmental assessment.** (USDOE Albuquerque Operations Office, NM. Uranium Mill Tailings Remedial Action Project Office). Jul 1988. 540p. NTIS, PC A23/MF A01; 1; GPO Dep. Order Number DE88013987/JAW.

The inactive Green River uranium mill tailings site is one mile southeast of Green River, Utah. The existing tailings pile is within the floodplain boundaries of the 100-year and 500-year flood events. The 48-acre designated site contains eight acres of tailings, the mill yard and ore storage area, four main buildings, a water tower, and several small buildings. Dispersion of the tailings has contaminated an additional 24 acres surrounding the designated site. Elevated concentrations of molybdenum, nitrate, selenium, uranium, and gross alpha activity exceed background levels and the proposed US Environmental Protection Agency (EPA) maximum concentration limits in the groundwater in the unconsolidated alluvium and in the shallow shales and limestones beneath the alluvium at the mill tailings site. The contamination is localized beneath, and slightly downgradient of, the tailings pile. The proposed action is to relocate the tailings and associated contaminated materials to an area 600 feet south of the existing tailings pile where they would be consolidated into one, below-grade disposal cell. A radon/infiltration barrier would be constructed to cover the stabilized pile and various erosion control measures would be taken to ensure the long-term stability of the stabilized pile. 88 refs., 12 figs., 20 tabs.

46443 **(RFP—4228) Treatment of radionuclide contaminated soils.** Pettis, S.A.; Kallas, A.J.; Kochen, R.L.; McGlochlin, S.C. (Rockwell International Corp., Golden, CO (USA). Rocky Flats Plant). Jun 1988. Contract AC04-76DP03533. 25p. (CONF-880801—1). NTIS, PC A03/MF A01; 1; GPO Dep. Order Number DE88012671/JAW.

From International reprocessing and waste management symposium; Denver, CO, USA (21 Aug 1988).

Rockwell, International, Rocky Flats Plants, is committed to remediating within the scope of RCRA/CERCLA, Solid Waste Managements Units (SWMUs) at Rocky Flats found to be contaminated with hazardous substances. SWMUs fund to have radionuclide (uranium, plutonium, and/or americium) concentrations in the soils and/or groundwater that exceed background levels or regulatory limits will also be included in this remediation effort. This paper briefly summarizes past and present efforts by Rockwell International, Rocky Flats Plant, to identify treatment technologies appropriate for remediating actinide contaminated soils. Many of the promising soil treatments evaluated in Rocky Flats' laboratories during the late 1970's and early 1980's are currently being revisited. These technologies are generally directed toward substantially reducing the volume of contaminated soils, with the subsequent intention of disposing of a small remaining concentrated fraction of contaminated soil in a facility approved to receive radioactive wastes. Treatment processes currently will be treated to remove actinides, and recycled back to the process. Past investigations have included evaluations of dry screening, wet screening, scrubbing, ultrasonics, chemical oxidation, calcination, desliming, flotation, and heavy-liquid density separation. 8 refs., 2 figs.

46444 **Analysis of source-term behavior in waste storage facilities.** Nguyen, D.H. *Transactions of the American Nuclear Society;* **55**: 75-76(1987). (CONF-8711195—).

From American Nuclear Society winter meeting; Los Angeles, CA, USA (15 Nov 1987).

By regulatory requirement, the Risk Characterization Program of waste management systems must include an analysis of radioactive materials deposition and plate-out within the operating facilities and their release to the environment following an accident. While the design of permanent repository surface facilities is still at an early stage, that of monitored retrievable storage (MRS) facilities is much more advanced and is used to represent the generic waste facilities. Because the functional requirement of MRS facilities is similar to that of permanent repository surface facilities, the results of this study should provide insight into the behavior of fission product (FP) source term in the latter as well. A unique aspect of the FP transport problem in repositories is the possibility of very small pressure differentials between cells; under these conditions, the gravitational and buoyancy effects may cause mass flow against the pressure gradient.

46445 **Assessing economic consequences of radiation accidents.** Rowe, M.D.; Lee, J.C.; Grimshaw, C.A.; Kalb, P.D. (Brookhaven National Lab., Upton, NY (USA)). *Transactions of the American Nuclear Society;* **55**: 76-78(1987). (CONF-8711195—).

From American Nuclear Society winter meeting; Los Angeles, CA, USA (15 Nov 1987).

A recent review of existing models and methods for assessing potential consequences of accidents in the high-level radioactive waste (HLW) disposal system identifies economic consequence assessment methods as a weak point. Existing methods have mostly been designed to assess economic consequences of reactor accidents, the possible scale of which can be several orders of magnitude greater than anything possible in the HLW disposal system. There is therefore some question about the applicability of these methods, their assumptions, and their level of detail to assessments of smaller accidents. The US Dept. of Energy funded this study to determine needs for code modifications or model development for assessing economic costs of accidents in the HLW disposal system. The objectives of the study were as follows: (1) review the literature on economic consequences of accidents to determine the availability of assessment methods and data and their applicability to the HLW disposal system before closure. (2) Determine needs for expansion, revision, or adaptation of methods and data for modeling economic consequences of accidents of the scale projected for the disposal system. (3) Gather data that might be useful for the needed revisions for modeling economic impacts on this scale.

46446 **Methodology and data base for transportation risk assessment.** Yuan, Y.C.; Chen, S.Y.; Saricks, C. (Argonne National Lab., IL (USA)). *Transactions of the American Nuclear Society;* **55**: 78-79(1987). (CONF-8711195—).

From American Nuclear Society winter meeting; Los Angeles, CA, USA (15 Nov 1987).

The Nuclear Waste Policy Act of 1982 established a process for selecting a geologic repository site for the disposal of spent nuclear fuel (SNF) and high-level radioactive waste (HLW). Following the nomination of three potential geological repository sites, the

US Dept. of Energy (DOE) published environmental assessments for the sites in 1986, which included potential issues raised by public commenters. The risks associated with transportation of SNF and HLW to the nominated sites are an issue of concern-in particular, the lack of route-specific risk analyses in the EAs and the generic nature of the RADTRAN-III computer code used for the analyses. To address these public concerns, the DOE Office of Civilian Radioactive Waste Management has initiated work to enhanced capabilities for more route-specific risk analyses. This work involves two major areas: (a) enhancement of data base and (b) enhancement of methodology.

46447 Residual radioactivity guidelines: a cost-benefit consideration. Yu, C.; Peterson, J.M.; Yuan, Y. (Argonne National Lab., IL (USA)). *Transactions of the American Nuclear Society;* **55**: 112-114(1987). (CONF-8711195—).

From American Nuclear Society winter meeting; Los Angeles, CA, USA (15 Nov 1987).

The US Dept. of Energy (DOE) has established radiological protection guidelines for cleanup of residual radioactive material located at sites administered under the Formerly Utilized Sites Remedial Action Program and Surplus Facilities Management Program. The methods and data for deriving site-specific guidelines and procedures for implementing DOE policy for reducing residual radioactivity to levels that are as low as reasonably achievable specify that, under reasonably foreseeable conditions, the annual radiation dose received by a member of the general public from residual radioactivity at a given site must not exceed 100 mrem (the basic dose limit) if the site is to be released for unrestricted use. This paper examines the relative effects of annual dose limits and cleanup costs on the allowable concentration of residual radioactivity. Two sites are analyzed: site A, a small site (1.4 ha) contaminated with uranium (an alpha emitter), and site B, a large site (77 ha) contaminated with ^{137}Cs (a beta-gamma emitter). For this analysis, uranium is assumed to consist of ^{238}U, ^{234}U, and ^{235}U in their naturally occurring activity concentration ratio.

46448 Safety aspects of gas centrifuge enrichment plants. Hansen, A.H. *Transactions of the American Nuclear Society;* **55**: 138(1987). (CONF-8711195—).

From American Nuclear Society winter meeting; Los Angeles, CA, USA (15 Nov 1987).

Uranium enrichment by gas centrifuge is a commercially proven, viable technology. Gas centrifuge enrichment plant operations pose hazards that are also found in other industries as well as unique hazards as a result of processing and handling uranium hexafluoride and the handling of enriched uranium. Hazards also found in other industries included those posed by the use of high-speed rotating equipment and equipment handling by use of heavy-duty cranes. Hazards from high-speed rotating equipment are associated with the operation of the gas centrifuges themselves and with the operation of the uranium hexafluoride compressors in the tail withdrawal system. These and related hazards are discussed. It is included that commercial gas centrifuge enrichment plants have been designed to operate safely.

46449 Future health physics prospects in high-level nuclear waste management. Waite, D.A.; Mayberry, J.J. *Transactions of the American Nuclear Society;* **52**: 104(1986). (CONF-860610—Summs.).

From American Nuclear Society annual meeting; Reno, NV, USA (15 Jun 1986).

The objective of this presentation is to provide an overview of health physics activities anticipated to be required at a high-level nuclear waste repository and to project the numbers of health physics personnel expected to be required to carry out these activities. Health physics personnel receiving consideration in the projections include the health physics manager, shift supervisors, area supervisors, health physicists, and technologists. Phases of the repository addressed are construction, operation, retrieval, and decommissioning. Specific topics discussed in the process of developing the projections are: (a) the basic features of a geologic repository, (b) the staffing requirements of such a repository, (c) health physics involvement in repository operations, and (d) the anticipated schedule for operation of repositories in the United States. A quantitative assessment of future health physics prospects in high-level nuclear waste management is included.

0550 Safeguards, Inspection, And Accountability

46450 (LA-UR—88-1892) Security features of a nuclear material accounting system. Erkkila, B.H. (Los Alamos National Lab., NM (USA)). 1988. Contract W-7405-ENG-36. 6p. (CONF-880631—40). NTIS, PC A02/MF A01; 1; GPO Dep. Order Number DE88014451/JAW.

From 29. annual meeting of the Institute of Nuclear Materials Management; Las Vegas, NV, USA (26 Jun 1988).

The Los Alamos Nuclear Material Accounting and Safeguards System (MASS) is a near-real-time accountability system for bulk materials, discrete items, and material undergoing dynamic processing. MASS has evolved from an eighty-column card based process control system to a very sophisticated computer system. The security of the MASS computer system is provide through various access controls. There are two kinds of access control to be addressed. They are physical access control to the hardware which make up the system, and access control to the software. There are many features which provide a measure of security to the hardware that will be discussed. Access to the software is controlled by a security password. Access to various transaction activities in the system is controlled through the level of MASS user privilege. Details of MASS user privilege will be discussed.

46451 (LA-UR—88-1991) The use of process information for verification of inventory in solvent extraction contactors in near-real-time accounting for reprocessing plants. Hakkila, E.A.; Barnes, J.W.; Hafer, J.F. (Los Alamos National Lab., NM (USA)). 1988. Contract W-7405-ENG-36. 6p. (CONF-880631—45). NTIS, PC A02. Order Number DE88014435/JAW.

From 29. annual meeting of the Institute of Nuclear Materials Management; Las Vegas, NV, USA (26 Jun 1988).

Near-real-time accounting is being studied as a technique for improving the timeliness of accounting in nuclear fuel reprocessing plants. A major criticism of near-real-time accounting is perceived disclosure of proprietary data for IAEA verification, particularly in verifying the inventory of solvent extraction contactors. This study indicates that the contribution of uncertainties in estimating the inventory of pulsed columns or mixer settlers may be insignificant compared to uncertainties in measured throughput and measurable inventory for most reprocessing plants, and verification may not be a serious problem. Verification can become a problem for plants with low throughput and low inventory in tanks if contactor inventory variations or uncertainties are greater than {approximately}25%. Each plant must be evaluated with respect to its specific inventory and throughput characteristics. 11 refs., 4 figs.

46452 (LA-UR—88-1992) Information management in the design of materials control and accountability systems. Whitty, W.J.; Markin, J.T.; Strittmatter, R.B. (Los Alamos National Lab., NM (USA)). 1988. Contract W-7405-ENG-36. 8p. (CONF-880631—44). NTIS, PC A02. Order Number DE88014434/JAW.

From 29. annual meeting of the Institute of Nuclear Materials Management; Las Vegas, NV, USA (26 Jun 1988).

This paper presents information management methods for materials accounting systems based on experience in systems development at DOE facilities. We describe principles for the acquistion and organization of data for a materials control and accountability (MC and A) system. Many of these principles are drawn from software engineering. These include the preparation of a requirements document, a functional specification, and the application of structured analysis and design. Insufficient effort and detail to these early fundamental activities for identifying and acquiring the appropriate data cause many problems later. Failure to provide for complete acquisition of all required information leads to potentially costly revisions to the data acquisition system or to a materials accounting system that cannot complete its intended functions. Likewise, unrealistic analyses requirements can cause catastrophic problems later on. 16 refs.

46453 **(LA-UR—88-2044) Automated methods for real-time analysis of spent-fuel measurement data.** Bosler, G.E.; Rinard, P.M.; Klosterbuer, S.F.; Painter, J. (Los Alamos National Lab., NM (USA)). 1988. Contract W-7405-ENG-36. 8p. (CONF-880631—37). NTIS, PC A02/MF A01; 1; GPO Dep. Order Number DE88014423/JAW.

From 29. annual meeting of the Institute of Nuclear Materials Management; Las Vegas, NV, USA (26 Jun 1988).

Software has been developed for "real-time" analysis of neutron and gamma data from GRAND-1/fork measurements on spent-fuel assemblies. Three modules compose the software package. The modules are linked through a database system of files. The first module is part of a general data-base processing code. This module prepares input data files with inventory and correction-factor information for the second module. The second module, called OLAF, operates on a computer attached to the GRAND-1 electronics unit. In this second module, neutron and gamma data from spent-fuel assemblies are analyzed to verify consistency in the facility operator declarations for exposure (burnup) and cooling time. From the analysis, potential discrepancies in the measurement data are questioned while equipment is still installed at the facility and is available for additional measurements. During the measurements, data are written to an output file, called a results file, which can be processed by the third module of the software package. In the third module, printed reports summarizing the data and results are prepared, and neutron and gamma data are written to files that are processed by the Deming curve-fitting code. 7 refs., 7 figs., 2 tabs.

46454 **(NUREG—0525-Rev.14) Safeguards summary event list (SSEL): Pre-NRC through December 31, 1987.** (Nuclear Regulatory Commission, Washington, DC (USA). Div. of Safeguards and Transportation). Jul 1988. 382p. NTIS, PC A17/MF A01 - GPO. Order Number TI88014087/JAW.

The Safeguards Summary Event List (SSEL) provides brief summaries of several hundred safeguards-related events involving nuclear material or facilities regulated by the US Nuclear Regulatory Commission (NRC). Events are described under the categories of bomb-related, intrusion, missing and/or allegedly stolen, transportation, tampering/vandalism, arson, firearms, radiological sabotage, nonradiological sabotage, alcohol and drugs, and miscellaneous. The information contained in the event descriptions is derived primarily from official NRC reporting channels.

46455 **(UCID—21419) Specialized assets of the US Department of Energy accident response group.** Nelson, W.E. (Lawrence Livermore National Lab., CA (USA)). Jun 1988. Contract W-7405-ENG-48. 8p. NTIS, PC A02/MF A01; 1; GPO Dep. Order Number DE88014695/JAW.

The US Department of Energy (DOE) has analyzed requirements for response to a nuclear weapon accident and taken steps to obtain and maintain technical assets needed to deal with such a problem. Two general problem areas have been considered{endash}recovering damaged weapon hardware and dealing with large-scale radiation contamination. Each problem area has generated needs for specialized equipment to be used by DOE technical specialists for minimizing the effects of a nuclear weapon accident on public health and safety and maximizing protection of the environment. Details of equipment requirements and acquisitions are described here.

46456 **(UCRL—98111) A consequence index approach to identifying radiological sabotage targets.** Altman, W.D.; Hockert, J.W. (Lawrence Livermore National Lab., CA (USA)). 26 Jun 1988. Contract W-7405-ENG-48. 5p. (CONF-880631—24). NTIS, PC A02/MF A01; 1; GPO Dep. Order Number DE88013096/JAW.

From 29. annual meeting of the Institute of Nuclear Materials Management; Las Vegas, NV, USA (26 Jun 1988).

One of the threats of concern to facilities using significant quantities of radioactive material is radiological sabotage. Both the Department of Energy (DOE) and the US Nuclear Regulatory Commission have issued guidance to facilities for radiological sabotage protection. At those facilities where the inventories of radioactive materials change frequently, there is an operational need for a technically defensible method of determining whether or not the inventory of radioactive material at a given facility poses a potential radiological sabotage risk. In order to determine quickly whether a building is a potential radiological sabotage target, Lawrence Livermore National Laboratory (LLNL) has developed a radiological sabotage consequence index that provides a conservative estimate of the maximum potential off-site consequences of a radiological sabotage attempt involving the facility. This radiological sabotage consequence index can be used by safeguards and security staff to rapidly determine whether a change in building operations poses a potential radiological sabotage risk. In those cases where such a potential risk is identified, a more detailed radiological sabotage vulnerability analysis can be performed. 1 tab.

46457 **(UCRL—98144) Measuring the safeguards value of material accountability.** Sicherman, A. (Lawrence Livermore National Lab., CA (USA)). 23 Jun 1988. Contract W-7405-ENG-48. 7p. (CONF-880631—29). NTIS, PC A02/MF A01; 1; GPO Dep. Order Number DE88014321/JAW.

From 29. annual meeting of the Institute of Nuclear Materials Management; Las Vegas, NV, USA (26 Jun 1988).

Material accountability (MA) activities focus on providing after-the-fact indication of diversion or theft of special nuclear material (SNM). MA activities include maintaining records for tracking nuclear material and conducting periodic inventories and audits to ensure that loss has not occurred. The MA system "alarms" when inventory differences exceed acceptable limits or when discrepancies arise between facility records and measured quantities of materials. Since MA alarms are typically too late to prevent theft or diversion of material, it is often difficult to value the safeguards contribution of MA. This paper presents a value model concept for assessing the safeguards benefits of MA activities and for comparing these benefits to those provided by PP and MC components. The model considers various benefits of MA, which include: 1) providing information to assist in recovery of missing material, 2) providing assurance that physical protection and material control systems have been working, 3) defeating protracted theft attempts, and 4) properly resolving causes of and responding appropriately to anomalies of missing material and external alarms (e.g., hoax). Such a value model can aid decisionmakers in allocating safeguards resources among PP, MC, and MA systems. 5 refs., 2 figs.

46458 **(WHC-SA—0105) Statistical inventory sampling system.** Greenfield, G.R. (Westinghouse Hanford Co., Richland, WA (USA)). Oct 1987. Contract AC06-87RL10930. 5p. (CONF-8710252—2). NTIS, PC A02/MF A01; GPO Dep. Order Number DE88013583/JAW.

From Westinghouse statistical symposium; Pittsburgh, PA, USA (19 Oct 1987).

Westinghouse Hanford Company employs statistical inventory sampling to verify the accuracy of the inventory information system. A computer program was written to perform statistical analysis, based on the inventory files and physical counting. This method determines inventory values with minimum manpower.

0560 Legislation And Regulations

REFER ALSO TO CITATION(S) 46401

46459 **NEPA and scientific uncertainty relating to inadequate information.** Hames, R.L. *Transactions of the American Nuclear Society;* **55**: 81-84(1987). (CONF-8711195—).

From American Nuclear Society winter meeting; Los Angeles, CA, USA (15 Nov 1987).

The National Environmental Policy Act (NEPA) was signed into law on January 1, 1970, and required, among other things, that all federal agencies assess the environmental impacts of and alternatives to proposals for major federal actions significantly affecting the quality of the human environment. Long before the promulgation of the regulations of the Counsel on Environmental Quality (CEQ), the courts developed a uniform body of law addressing the problem confronted by federal agencies lacking information as to the impacts of its proposed action. When CEQ developed its regulations in 1978, Sec. 1502.22 of these rules included a requirement for a worst-case analysis. On April 25, 1986, CEQ issued its final

rule amending Section 1502.22 concerning incomplete or unavailable information. In summary, the rule now provides that if information relevant to reasonably foreseeable significant adverse impacts cannot be obtained, the agency shall include in the EIS a statement that such information is incomplete or unavailable, a statement of the relevance of the incomplete or unavailable information to evaluating the impacts, and a summary of existing credible scientific evidence that is relevant to evaluating these adverse impacts.

07 ISOTOPE AND RADIATION SOURCE TECHNOLOGY

0701 Physical Isotope Separation

46460 **(MLM—3509(OP)) Operating experience with the Hydrogen Isotope Separation System at Mound.** Embury, M.C.; Erwin, M.G.; Levan, D.A. (Monsanto Research Corp., Miamisburg, OH (USA). Mound). 1988. Contract AC04-76DP00053. 7p. (CONF-880505—38). NTIS, PC A02. Order Number DE88012874/JAW.

From 3. topical meeting on tritium technology in fission, fusion and isotopic applications; Toronto, Canada (1 May 1988).

The Hydrogen Isotope Separation System (HISS) is a general-purpose tritium recovery and enrichment processor that uses low-temperature distillation as the separation process. HISS processes feed mixtures containing all three isotopes of hydrogen (H,D,T) and yields an enriched tritium product up to 99.95% tritium, while producing a discardable raffinate. The three-column system operates continuously with unattended overnight operation and limited operation during weekends. Production runs with a full still inventory were started in October 1987, with individual runs lasting up to seven weeks. 6 refs., 2 figs., 1 tab.

0702 Radiation Sources

REFER ALSO TO CITATION(S) 47049, 47121

46461 **Californium-252 sales and loans at Oak Ridge National Laboratory.** King, L.J. (Oak Ridge National Lab., TN (USA)). *Transactions of the American Nuclear Society;* **55**: 241-242(1987). (CONF-8711195—).

From American Nuclear Society winter meeting; Los Angeles, CA, USA (15 Nov 1987).

The production and distribution in the United States of ^{252}Cf has recently been consolidated at the Oak Ridge National Laboratory (ORNL). The ^{252}Cf Industrial Sales/Loan Program and the ^{252}Cf University Load Program, which were formerly located at the Savannah River Plant (SRP), have been combined with the californium production and distribution activities of the Transuranium Element Production Program at ORNL. Californium-252 is sold to commercial users in the form of bulk californium oxide, palladium-californium alloy pellets, or alloy wires. Neutron source capsules, which are fabricated for loans to DOE or other US government agencies, are still available in all forms previously available. The consolidation of all ^{252}Cf distribution activities at the production site is expected to result in better service to users. In particular, customers for neutrons sources will be ale to select from a wider range of neutron source forms, including custom designs, through a single contact point.

08 HYDROGEN

0801 Production

REFER ALSO TO CITATION(S) 47118

46462 **(PIRSEM—3064) Study of the catalytic properties of hydrogenase with a view to its utilization for hydrogen photoproduction.** Hatchikian, C.; Niviere, V. (Centre National de le Recherche Scientifique, 75 - Paris (France). Programme Interdisciplinaire de Recherche sur les Sciences pour l'Energie et les Matieres Premieres). 1986. 11p. (In French). NTIS (US Sales Only), PC A03/MF A01. Order Number DE88754216/JAW.

In the first part of the article, recent developments on the characteristics of the active center and the activity mechanisms of the Desulfovibrio gigas hydrogenase are presented. In the second part, results concerning the photoproduction of hydrogen through the coupling of this hydrogenase with a semi-conductor type photoreceptor are discussed. Various electrodes have been experimented (Ga As, platinum) and compared with respect to the hydrogen production rates.

0808 Properties

46463 (INIS-BR—1164, pp 116) **Electronic shielding nearby the molecular hydrogen - metallic hydrogen transition.** Oliveira, F.A.; Ferraz, A. (Brasilia Univ. (Brazil). Dept. de Fisica). 1987. (In Portuguese). NTIS (US Sales Only), PC A09/MF A01. Order Number DE88703566/JAW. (CONF-8705181—).

From 10. national meeting on condensed matter physics; Caxambu, Brazil (5 May 1987).

46464 **Synchrotron x-ray diffraction measurements of single-crystal hydrogen to 26.5 gigapascals.** Mao, H.K.; Jephcoat, A.P.; Hemley, R.J.; Finger, L.W.; Zha, C.S.; Hazen, R.M.; Cox, D.E. (Brookhaven National Lab., Upton, NY (USA)). *Science (Washington, D.C.);* **239**: 1131-1134(4 Mar 1988). Contract AC02-76CH00016.

The crystal structure and equation of state of solid hydrogen have been determined directly to 26.5 gigapascals at room temperature by new synchrotron x-ray diffraction techniques. Solid hydrogen remains in the hexagonal close-packed structures under these pressure-temperature conditions and exhibits increasing structural anisotropy with pressure. The pressure-volume curve determined from the x-ray data represents the most accurate experimental measurement of the equation of state to date in this pressure range. The results remove the discrepancy between earlier indirect determinations and provide a new experimental constraint on the molecular-to-atomic transition predicted at higher pressures. 22 references, 4 figures.

09 OTHER SYNTHETIC AND NATURAL FUELS

0901 Hydrocarbon Fuels

REFER ALSO TO CITATION(S) 47090

46465 **(CONF-8610426—Vol.1) Renewable raw materials - potentials and limits of production and use of inland plant for industrial use. Statements of experts and industrial associations. Vol. 1.** (Bundesministerium fuer Forschung und Technologie, Bonn (Germany, F.R.); Bundesministerium fuer Ernaehrung, Landwirtschaft und Forsten, Bonn (Germany, F.R.)). Oct 1986. 167p. (In German). NTIS (US Sales Only), PC A08. Order Number DE88770273/JAW.

From Expert colloquium on renewable raw materials; Bonn, F.R. Germany (14 Oct 1986).

Uses of biomass plantations in the chemical industry for the production of vegetable oils, fats, lipids, paper and fuel substitution are discussed. Production and economics of bioethanol as biological fuel receive special attention. The fundamental criteria of plant breeding for biomass plantations are mentioned. (MBC).

46466 **(CONF-8610426—Vol.2) Renewable raw materials - potentials and limits of production and use of inland plant for industrial use. Statements of experts and industrial associations. Vol. 2.** (Bundesministerium fuer Forschung und Technologie, Bonn (Germany, F.R.); Bundesministerium fuer Ernaehrung, Landwirtschaft und Forsten, Bonn (Germany, F.R.)). Dec 1986. 146p. (In German). NTIS (US Sales Only), PC A07. Order Number DE88770274/JAW.

From Expert colloquium on renewable raw materials; Bonn, F.R. Germany (14 Oct 1986).

Uses of biomass plantations in the chemical industry for the production of vegetable oils, fats, lipids, paper and ethanol are discussed. Production and economics of bioethanol as biological fuel receive special attention. The fundamental criteria of plant breeding for biomass plantations are mentioned. (MBC).

46467 **(DOE/ER/13053—7) Energetics of end product excretion in anaerobic bacteria and the metabolism of fatty acids by Syntrophomonas wolfei: Progress report, March 15, 1985--June 30, 1988.** McInerney, M.J. (Oklahoma Univ., Norman (USA)). 1988. Contract AS05-83ER13053. 16p. NTIS, PC A03/MF A01; 1; GPO Dep. Order Number DE88014744/JAW.

We developed methods to physically separate cells of the anaerobic, fatty acid degrade, Syntrophomonas wolfei, from cells of the hydrogen user by Percoll gradient centrifugation and to selectively lyse S. wolfei cells using lysozyme. These methods allowed the study of the physiology of S. wolfei without significant contamination. Fatty acids were degraded by the B-oxidation pathway using a coenzyme A (CoA) transferase activity to activate the fatty acid and substrate- level phosphorylation reactions to synthesize. The substrate specificity of the CoA transferase activity in the pure culture of S. wolfei differed from that found in the coculture suggesting that the ability to use crotonate resulted from an alteration of this enzyme. S. wolfei grown alone degraded crotonate in a manner similar to that of other crotonate-fermenting anaerobes, but the molar growth yields of S. wolfei were 2 to 3 times higher than those organisms. This suggests that the reduction of crotonyl-CoA to butyryl-CoA is energy yielding. S. wolfei contained a c-type cytochrome which may be involved in this reaction. S. wolfei synthesized large amounts of the storage polymer, poly-B-hydroxybutyrate.

46468 **(DOE/PC/80015—11) Fischer-Tropsch slurry phase process variations to understand wax formations: Quarterly report for period, April 1, 1988-June 30, 1988.** Donnelly, T.; Satterfield, C.N. (Massachusetts Inst. of Tech., Cambridge (USA). Dept. of Chemical Engineering). 1988. Contract AC22-85PC80015. 75p. NTIS, PC A04/MF A01; 1; GPO Dep. Order Number DE88012966/JAW.

A precipitated iron Ruhrchemie catalyst formerly used at the SASOL operations in South Africa and similar to that currently used was studied in a continuous-flow well-stirred slurry reactor at 232{degree} C to 263{degree}C, 2.16 to 2.98 MPa, H_2/CO feed ratios of 0.70 to 0.78 and syngas conversions of 15 to 65%. The carbon number distribution of the hydrocarbon products followed a Schulz-Flory distribution with two values of α. These distributions are compared to those of several other iron catalysts. Selectivity to 1-alkenes increased with temperature. Secondary hydrogenation of 1-alkenes is shown to be a major pathway to n-alkanes. Activity for the water-gas shift is much less than that for other iron catalysts. 31 refs., 17 figs., 7 tabs.

46469 **(DOE/PC/90008—T3) Heat transfer investigations in a slurry bubble coulmn: Quarterly report of the period January--March 1988.** Saxena, S.C. (Illinois Univ., Chicago (USA). Dept. of Chemical Engineering). [1988]. Contract AC22-86PC90008. 29p. NTIS, PC A03/MF A01; 1; GPO Dep. Order Number DE88015481/JAW.

The small 10.8 cm diameter Plexiglas slurry bubble column has been operated in various modes and in different evironment. It has been used to measure heat transfer coefficient between a heat transfer probe of 19 mm diameter place coaxially and air-water dispersion as a function of air velocity. The effect of water flow velocity, position of heat-transfer section and heat flux value on heat-transfer coefficient has been studied and discussed. The uncertainty in the measurements have been determined. To study the heat trasfer mechanism, experiments were conducted to measure fluctuating heat-transfer coefficient at a sampling rate of 10 readings per minute. The experiments were also conducted to measure the local temperature on heat transfer surface at a high sampling rate of 20 readings per second. The design, fabrication and installation work on the larger 0.305 m diameter column has progressed and it is expected that various flow loops and measuring circuits will be completed shortly. A heat transfer probe of 19 mm diameter is in the advanced stage of fabrication. A special circuit is assembled to energize the electrical heater. Interpretation of our experimental air holdup data for different operating conditions in terms of available correlations are presented. 18 refs., 15 figs., 3 tabs.

46470 **(DOE/PC/90008—T4) Heat transfer investigations in a slurry bubble column: Quarterly report of the period April--June 1988.** Saxena, S.C.; Vadivel, R.; Verma, A.K. (Illinois Univ., Chicago (USA). Dept. of Chemical Engineering). [1988]. Contract AC22-86PC90008. 30p. NTIS, PC A03/MF A01; 1; GPO Dep. Order Number DE88015482/JAW.

Detailed measurements of gas holdup in the small 10.8 cm diameter column have been completed for the two-phase air-water system. Experiments have been conducted in the semi-batch mode as well as in the continuous mode as a function of air velocity. Experiments are done to see the influence, if any, of the 19 mm diameter axial probe in the column on air holdup. The experiments are also conducted for the three-phase, air-water-glass bead system, and phase holdup are measured as a function of air velocity, water column height, solids concentration, and with and without the presence of an axial heat transfer probe. The heat transfer coefficient between the single axial 19 mm diameter probe and the three-phase dispersion is measured as a function of time, air velocity and solids concentration. In order to understand the mechanism of heat transfer, the variation of local temperature history of an element of the heater surface is recorded for the two-and three-phase systems. Two pressure profile measuring devices for the larger 30.5 cm diameter slurry bubble column have been completed and measurements of gas holdup as a function of air velocity, initial water column height, and with and without the presence of heat transfer probe are reported for the two-phase air-water system. Interpretation of the gas holdup data both total and local is completed on the basis of available correlations. The heat transfer data are examined and analyzed on the basis of data of the other workers, correlation and theoretical models. 18 refs., 12 figs., 2 tabs.

46471 **(DOE/PC/90008—T6) Heat transfer investigations in a slurry bubble column: Quarterly report for the period September--November, 1986.** Saxena, S.C.; Revankar, V.V.S.; Shrivastava, S. (Illinois Univ., Chicago (USA). Dept. of Chemical Engineering). [1988]. Contract AC22-86PC90008. 11p. NTIS, PC A03/MF A01; 1; GPO Dep. Order Number DE88015484/JAW.

The initial design of the 10.8 cm internal diameter Plexiglas slurry bubble column as well as of the associated gas and slurry flow loops with temperature and pressure measuring devices is completed, and order for most of the required materials is placed. The design of the heat transfer probes is developed and all the basic components have been ordered. These designs are briefly described in this report. The fabrication of the column and of the auxiliary units is in progress and installation of the column will soon start. 6 figs.

46472 **(ETSU-B—1159) Basic study of landfill microbiology and biochemistry.** (UKAEA Harwell Lab. Energy Technology Div.). 1988. 90p. British Library Document Supply Centre, Boston Spa, Wetherby, West Yorks. LS23 7BQ.

The current level of understanding of the biochemistry and microbiology of anaerobic digestion, with particular reference to

the disposal of refuse and methanogenic activity in sanitary landfill is reviewed. Potentially, biogas production from refuse is a rich and renewable source of energy but reported yields are generally low in comparison with the theoretical estimates. Although it is well known that biogas production is the result of microbiological and biochemical processes, there is a distinct lack of direct knowledge of the basic microbiology and biochemistry involved in refuse degradation. Hitherto it has been assumed that the process of degradation in a landfill is similar to that described for other anaerobic environments, eg. sludge stabilisation, rumen, sediments and industrial wastewater digesters, but unlike the feedstock in other systems, landfill refuse is a solid.

46473 (ORNL/TM—10626) Second-year growth and productivity for potential herbaceous energy crops in the southeast and midwest/lake states. Turhollow, A.F. (Oak Ridge National Lab., TN (USA)). Jul 1988. Contract AC05-84OR21400. 32p. NTIS, PC A03/MF A01; 1; GPO Dep. Order Number DE88013222/JAW.

The results of the second year of the lignocellulosic energy crop screening projects in the Southeast and Midwest/Lake States of the Herbaceous Energy Crops Program are summarized. Most species being screened are grasses, both annual and perennials, and legumes. Establishment of perennial crops was completed during the second year. Yields were quite variable, ranging from 0 for flatpea at a drought-stricken site in Virginia to as high as 31.0 Mg/ha for a sweet sorghum-rye double crop at a site in Indiana. The yield data collected - along with agronomic input, machinery, and labor requirements - will be combined in the future to help select the best species for further development as energy crops. 3 refs., 1 fig. 14 tabs.

46474 (PNL-SA—16031) Improved gasification by catalytic destruction of tars in biomass-derived gases. Mudge, L.K.; Gerber, M.A.; Wilcox, W.A. (Pacific Northwest Lab., Richland, WA (USA)). Jun 1988. Contract AC06-76RL01830. 15p. (CONF-8806176—3). NTIS, PC A03/MF A01; 1; GPO Dep. Order Number DE88014082/JAW.

From Thermochemical conversion program review meeting; Golden, CO, USA (21 Jun 1988).

Currently many biomass gasifiers generate a significant amount of tars in the product gases. These tars create problems with plugging in downstream equipment and with wastewater treatment. Partial oxidation of the gas stream in a secondary fluid bed of catalyst destroys the tars in biomass-derived gases while increasing the energy content of the product gas. Catalysts that remain active for tar destruction are used in the secondary reactor which is specially designed to promote removal of carbon from the catalyst surface while minimizing oxidation of combustible product gases such as CO and H{sub 2}. Gases containing tars were generated from wood by pyrolysis, steam gasification, and air/steam gasification in a fluid bed at 1340{degree}F (725{degree}C). Tars were destroyed and gas yields improved by catalytic partial oxidation in a secondary reactor. Improvement in gas yield depended on conditions in the primary reactor, which influenced the tar content of the wood-derived gases. Tars were converted to gases by partial oxidation in the secondary catalytic reactor at a temperature as low as 1110{degree}F (600{degree}C). Recent experimental results are presented in this status report. 9 refs., 6 figs., 3 tabs.

46475 Theoretical studies of the energetics and dynamics of chemical reactions. Dunning, T.H. Jr.; Harding, L.B.; Wagner, A.F.; Schatz, G.C.; Bowman, J.M. (Argonne National Lab., IL (USA)). *Science (Washington, D.C.);* 240: 453-459(22 Apr 1988). Contract W-31-109-ENG-38.

Computational studies of basic chemical processes not only provide numbers for comparison with experiment or for use in modeling complex chemical phenomena such as combustion, but also provide insight into the fundamental factors that govern molecular structure and change which cannot be obtained from experiment alone. The results of three cases studies, on HCO, OH + H_2 and O + C_2H_2, which illustrate the range of problems that can be addressed by using modern theoretical techniques are summarized. In all cases, the potential energy surfaces were characterized by using ab initio electronic structure methods. Collisions between molecules leading to reaction or energy transfer were described with quantum dynamical methods (HCO), classical trajectory techniques (HCO and OH + H_2), and statistical methods (HCO, OH + H_2, and O + C_2H_2). Dramatic increases in the scope of this work are anticipated as new generations of computers are introduced and as new chemistry software is developed to exploit these computers. 54 references, 6 figures, 1 table.

0902 Alcohol Fuels

REFER ALSO TO CITATION(S) 46760

46476 (AFME—84-1776) Study and development of membrane bioreactors for continuous extraction of organic solvents obtained by fermentation. Prebois, J.P. (Agence Francaise pour la Maitrise de l'Energie, 75 - Paris). 1985. 36p. (In French). NTIS (US Sales Only), PC A03/MF A01. Order Number DE88754215/JAW.

Two anaerobic fermentation processes have been performed and evaluated with the objective of enhancement of the viable microorganism concentration and their productivity. The processes are the ethanolic fermentation (fed-batch, continuous process with cell recycling or with fixed cells) and the acetonobutylic fermentation (identification of the best phylum. Clostridium acetobutylicum - and optimization of the medium).

46477 (PNL—6570) Conversion of forest residues to a methane-rich gas in a high-throughput gasifier. Feldmann, H.F.; Paisley, M.A.; Appelbaum, H.R.; Taylor, D.R. (Battelle Columbus Div., OH (USA)). May 1988. Contract AC06-76RL01830. 108p. NTIS, PC A06/MF A01; 1; GPO Dep. Order Number DE88013138/JAW.

Research was conducted in a process research unit to develop an entrained bed gasifier which is supplied heat by recirculating a stream of sand between a separate combustion vessel and the gasifier. The char remaining after gasification of the wood provides the fuel for the combustor. The research program was conducted in two phases. In the first phase, a 6 in. I.D. gasifier was used to establish the feasibility of the concept for a wide variety of biomass feeds. The second phase of the program was conducted with a 10 in. I.D. gasifier, and a fully automated feeder system, to evaluate gasifier performance at very high feed rates. The experimental results were used to develop design parameters and detailed energy and material balances for a conceptual plant. A preliminary cost analysis is presented in the report based on the conceptual design. 5 refs., 24 figs., 13 tabs.

46478 (SERI/SP—231-3331) FY 1987 anaerobic digestion: Annual report. (Solar Energy Research Inst., Golden, CO (USA)). Jul 1988. Contract AC02-83CH10093. 221p. NTIS, PC A10. Order Number DE88001172/JAW.

Anaerobic digestion research is being undertaken by the Department of Energy (DOE) under the field management of the Solar Energy Research Institute (SERI) and is sponsored as part of the Energy from Municipal Waste Research Program to produce methane from biomass and waste. Primary focus is on municipal solid waste (MSW) as a feedstock; however, some efforts are ongoing using other biomass feedstocks. MSW represents a vast resource for energy production; however, its variability presents unique problems in using it as a feedstock. To make methane production from waste and biomass economical, researchers are addressing three major technological improvements: increasing solids loading, decreasing solids residence time, and improving conversion efficiency. Improvements have been made in all three areas through biological and engineering research activities and have resulted in a decrease in methane production cost from approximately $8.00/million Btu in 1980 to $5.00/million Btu today. Future research will continue to increase our understanding of the organisms involved in the anaerobic digestion process and their interactions. Both biological and engineering research will continue in order to decrease the cost of methane to less than $3.50/million Btu by the year 2000.

0904 Solid Waste And Wood Fuels

REFER ALSO TO CITATION(S) 46756, 47136

46479 **(PNL—6565) Evaluation of manure as a feedstock for gas turbines.** Hamrick, J.T. (Pacific Northwest Lab., Richland, WA (USA); Aerospace Research Corp., Roanoke, VA (USA)). May 1988. Contract AC06-76RL01830. 60p. NTIS, PC A04. Order Number DE88013136/JAW.

A preliminary program on evaluation of feedlot manure as a feed stock for gas turbines has been completed. It was determined that manure can be pulverized and fed into a gas turbine combustion system with the manure burning in much the same manner as a liquid or gaseous fuel. Ash and dirt in the manure did not appear to have a significant effect on combustion and were effectively removed by the cyclone filters. The exhaust gases varied from clear to a blue haze. Severe problems were encountered with slagging of the hot refractory walls of the combustor. Development of a suitable combustor will be required before a commercial size system can be designed. 10 refs., 10 figs., 3 tabs.

13 HYDRO ENERGY

REFER ALSO TO CITATION(S) 46698

1303 Plant Design And Operation

46480 (OME—2121983, pp 11) **Case Study: the Peterborough Pumphouse.** Edwards, K.L.; Fuhrmann, J.; Rowe, I.H. (Peterborough Utilities Commission, Ont., Canada; SNC Inc., central Canada). 2 Dec 1983. CANMET/TID, Energy, Mines and Resources Canada, 555 Booth St., Ottawa, Ont., Canada K1A 0G1; $0.34CAN per page, $3.40 CAN minimum. (CE—01648; CONF-8311312—).

From Small hydro workshop; Toronto, Canada (30 Nov 1983).

The Peterborough (Ontario) Utilities Commission operates a pumphouse equipped with four turbines on the Otonabee River. Three of these drive pumps for municipal water supply while the fourth has been unused for a number of years. This project is concerned with the refurbishing of the fourth turbine, rated at 300 hp, to provide electrical power. This paper describes the decision to redevelop the pumphouse, the site development process, and the economics of the project. The system when completed will provide 1,350 MWh of energy per year at a cost of $1,567/kW.

1304 Regulations And Licensing

46481 (OME—2121983, pp 11) **Policy and activities: Ontario Ministry of Natural Resources.** Chang, R. (Ministry of Natural Resources, Toronto, Ont., Canada). 2 Dec 1983. CANMET/TID, Energy, Mines and Resouorces Canada, 555 Booth St., Ottawa, Ont., Canada K1A 0G1; $0.34CAN per page, $3.40 CAN minimum. (CE—01648; CONF-8311312—).

From Small hydro workshop; Toronto, Canada (30 Nov 1983).

The Ontario government is committed to the coordination and implementation of an overall program to encourage small hydro development and has directed the Ministries of Energy and Natural Resources (MNR) to carry out this task. Because water power development usually involves Crown lands under the administration and control of MNR, this Ministry has a major role in the program, including that of ensuring that proposed developments are fully reviewed, both internally and publicly before being offered for dispostion. A program to take inventory and assess existing sites for their potential for small water power development is nearig completion. A listing of sites in categories ranging from highest potential to lowest potential is being prepared and will be available to the general public. MNR intends to offer some sites for development in the near future. Currently, 7 sites are being developed under a joint Federal/Provincial Small Hydro-electric Demonstraion Project, with which MNR has acted in an advisory capacity. Experience with the implementation of the three small hydro demonstration projects and the 7 sites now being developed has demonstrated that obtaining approvals from MNR is not a major concern. A series of outlines given in this report shows the approval steps necessary for three different site ownership considerations. Unless the Crown owns no part of the site, a water power lease agreement is also required; conditions and applicable rents are briefly described.

1305 Economics And Management

REFER ALSO TO CITATION(S) 46480

46482 (OME—2121983, pp 6) **Case study: the Elora Mill.** Taylor, C. (The Elora Mill, Ont., Canada). 2 Dec 1983. CANMET/TID, Energy, Mines and Resources Canada, 555 Booth St., Ottawa, Ont., Canada K1A 0G1/ $0.34CAN per page, $3.40 CAN minimum. (CE—01648; CONF-8311312—).

From Small hydro workshop; Toronto, Canada (30 Nov 1983).

The Elora Mill in Elora, Ontario, first operated as a grist mill in the 1840s. The present five-story structure, which was built on the foundation of the original mill, is made entirely of limestone and was opened in 1859. The mill operated successfully until 1974 and is reputed to be the largest converted grist mill in North America. Conversion of the structure to a country inn took almost two years and was opened for business in January of 1976. The mill is located at the top of a gorge and cascade, and the property starts at a point where a dam was constructed. The head of water is 32 ft and the flow is sufficient to produce adequate electric power for the property. Studies were undertaken to test the feasibility of a self-generating program for a number of reasons, including energy conservation and economic feasibitlity. Including provincial subsidies and assuming presently advantageous tax structures, the repayment period should be about eight years and should result in cost savings (based on present energy costs) of about 85%. Personnel selection has been carried out and construction has started.

46483 (OME—2121983, pp 11) **Case studies: Canada/ Ontario small hydroelectric demonstrations in Ontario.** Stevens, S. 2 Dec 1983. CANMET/TID, Energy, Mines and Resources Canada, 555 Booth St., Ottawa, Ont., Canada K1A 0G1; $0.34CAN per page, $3.40 CAN minimum. (CE—01648; CONF-8311312—).

From Small hydro workshop; Toronto, Canada (30 Nov 1983).

Under the program "Small Hydroelectric Demonstrations in Ontario", funds are provided to achieve the following objectives: encourage small hydro installations; create jobs in small hydro equipment production and construction; improve the ability of manufacturing, consulting and construction firms to fabricate, design and install small hdyro systems; improve the capacity of Canadian industry to meet the demand for small hydro equipment domestically and for the export market; and develop greater public awareness and acceptance of small hydro. The program was widely advertised and 25 project proposals were received, of which 18 were eligible for evaluation. Projects were analyzed according to various technical criteria and rated according to the relative technical merit of each. Economic evaluation was also undertaken, including a 15-year cash flow analysis, and projects with rates of return from 5-20% were considered to be the most appropriate for fund contributions under the program. A summary chart was prepared indicating the results of all 18 projects in all 3 categories. Seven projects were selected for funding, the financial assistance totalling about $800,000. A brief description of four of the selected projects is included in this report. 5 tabs.

46484 (OME—2121983, pp 38) **Feasibility of small hydro: economics and financing of small hydro.** Burrell, T.; Sud, S.K. (Victor & Burrell Research & Consulting, Canada). 2 Dec 1983. CANMET/TID, Energy, Mines and Resources Canada, 555 Booth St., Ottawa, Ont., Canada K1A 0G1; $0.34CAN per page, $3.40 CAN minimum. (CE—01648; CONF-8311312—).

From Small hydro workshop; Toronto, Canada (30 Nov 1983).

This paper is intended as a beginning guide to the economic and financial issues relating to a small hydro project. The first section of the paper addresses economic evaluation. It discusses the revenue and cost elements which should be included in an economic evaluation and explores the evaluation criteria to be used. All revenue and cost elements should be identified early on in the project assessment process. Economic performance indicators such as net present value should be used to ascertain the project's economic viability under a range of alternative assumptions about revenues and costs. The second section of the paper deals with financing. It discusses the nature of the current challenge faced by small hydro proponents and examines conventional approaches to financing these projects. It concludes with a discussion of some of the non-conventional financing approaches which may be used when the more conventional sources are not available, such as lease financing, financing rom equipment manufacturers and limited partnership financing. 1 figs., 4 tabs.u

46485 (OME—2121983, pp 15) **The feasibility of small hydro: a site ranking and cost methodology.** Gordon, J.L. (Montreal Enigneering Co. Ltd., Quebec, Canada). 2 Dec 1983. CANMET/TID, Energy Mines and Resources Canada, 555 Booth St., Ottawa, Ont., Canada K1A 0G1; $0.34CAN per page, $3.40 CAN minimum. (CE—01648; CONF-8311312—).

From Small hydro workshop; Toronto, Canada (30 Nov 1983).

In Ontario, there are hundreds of potential small hydro sites. The question is which of these are economic and worthy of development. Visiting each site is not effective, and cannot be justified due to the exorbitant cost. This paper outlines a simple methodology which can be used to rank sites. Based on a minimum-cost formula and on twelve site parameters whose values can be derived from a map study. It uses "SHYDRO", a cost estimating computer program, specifically developed for small hydro work in the Maritimes, and adapted to include small hydro sites at remote communities. 4 refs.

1306 Environmental Aspects

REFER ALSO TO CITATION(S) 47343

1307 Power-conversion Systems

46486 (OME—2121983, pp 10) **Canadian technology: Barber Hydraulic Turbine.** Wilson, M.R. (Barber Hydraulic Turbine, Port Colborne, Ont., Canada). 2 Dec 1983. CANMET/TID, Energy, Mines and Resources Canada, 555 Booth St., Ottawa, Ont., Canada K1A 0G1; $0.34CAN per page, $3.40 CAN minimum. (CE—01648; CONF-8311312—).

From Small hydro workshop; Toronto, Canada (30 Nov 1983).

This paper describes some of the technology developed by Barber Hydraulic Turbine, a Canadian manufacturer and refurbisher of small to medium size (50 kW-15,000 kW) water turbines. The technology featured in this report is the Mini-Hydel station, an integrated, pre-assembled and self-contained hydroelectric power package designed for low head sites (under 40 ft). Immediate applications are to small isolated communities now serviced by fossil fuel powered generating plants. The equipment is designed to require a minimum of on-site work, and is designed to operate unattended except for routine maintenance. Hydraulically, the turbine efficiency is 85-90%; provision for voltage regulation is included if necessary (i.e., for sites not located near existing transmission facilities). The unit can be provided for various types of installation, such as in a flume or with a penstock and prefabricated intake structure. Barber also can provide Francis runners, which have the advantages of low velocity water discharge, freedom from cavitation in low head installations, and possible 90% hydraulic efficiency. Cost estimates for Mini-Hydel's systems in general are given, and on low head sites the cost should not exceed about $1,200 per kW.

46487 (OME—2121983, pp 9) **Canadian technology: Galt Energy Systems.** DeMontmorency, D. (Galt Energy Systems Ltd., Canada). 2 Dec 1983. CANMET/TIC, Energy, Mines and Resources Canada, 555 Booth St., Ottawa, Ont., Canada K1A 0G1; $0.34CAN per page, $3.40 CAN minimum. (CE—01648; CONF-8311312—).

From Small hydro workshop; Toronto, Canada (30 Nov 1983).

This paper begins with the history of water power in Canada and an outline of the development of turbine technology for hydroelectric sites. Comparison is then made with the requirements of today. To develop small hydro with reasonable payback, costs should be kept down to little over $1,000 per kkW; recently developed technology has made this possible due to less need for speed regulation (taken care of by the fact that grid frequency is controlled by the very large turbines) and the acceptance of induction generation. The design approach taken by Galt Energy Systems, which produces turbines especially designed for small and mini hydroelectric sites, is described, featuring the "L" turbine, a low head machine for sites with up to 50 ft. of drop. These are being used at sites in Elora and Brantford in Ontario. The Millcroft Inn site installation is presented as an example of the packaging flexibility that is needed to develop small sites. The site uses a packaged power station that was delivered and assembled in just one day, with conrete work and commissioning in the following week. It is an automatic station that has advantages of minimum site work, compact size, low head requirement, and adaptability to hitherto nonviable sites. A brief discussion of the economics of scale possible with small hydro plants concludes this report.

14 SOLAR ENERGY

1401 Resources And Availability

46488 (NP—8770386) **Parameterization of the radiation balance. Reporting period: October 1, 1982 to September 30, 1985. Final report.** Scholz, R. (Muenchen Univ. (Germany, F.R.). Meteorologisches Inst.). Mar 1986. 26p. (In German). NTIS (US Sales Only), PC A03/MF A01. Order Number DE88770386/JAW.

In the course of the project, the radiation density program was extended to permit realistic modelling of the atmospheric radiation fields by random stratification of the extinguishing medium. Combined with a number of auxiliary programs, this enables studies also of atmospheres with high optical density. Sensitivity studies were carried out, e.g., on the influence of curl clouds on the shortwave radiation balance in all atmospheric conditions. The researchers wanted to find out if curl clouds can be distinguished from aerosol layers on the basis of the significant changes in radiation density distribution at the upper and lower edge of the atmosphere. Better results can only be achieved by a numerically exact treatment of the curl cloud scattering function.

1403 Economics

REFER ALSO TO CITATION(S) 46499

1404 Environmental, Legal, And Institutional Aspects

REFER ALSO TO CITATION(S) 46702

1405 Solar Energy Conversion

REFER ALSO TO CITATION(S) 46465, 46466, 46467, 46472, 46474, 46477, 46478, 46503, 46510, 47006

46489 (CONF-880521—1) **A composite photobioelectronic material.** Greenbaum, E. (Oak Ridge National Lab., TN (USA)). 1988. Contract AC05-84OR21400. 20p. NTIS, PC A03/MF A01; 1; GPO Dep. Order Number DE88012490/JAW.

From 10. symposium on biotechnology for fuels and chemicals; Gatlinburg, TN, USA (16 May 1988).

The research described presents a method for chemically modifying the surface of green plant photosynthetic membranes in such a way that electrical contact can be made. Colloidal platinum was prepared, precipitated directly onto photosynthetic thylakoid membranes from aqueous solution, and entrapped on fiberglass filter paper. This composition of matter was capable of sustained simultaneous photoevolution of hydrogen and oxygen when irradiated at any wavelength in the chlorophyll absorption spectrum. Experimental data support the interpretation that part of the platinum metal catalyst is precipitated adjacent to the photosystem-I reduction site of photosynthesis and that electron transfer occurs across the interface between photosystem-I and the catalyst. When contacted with metal electrodes, the thylakoid-platinum combination is capable of generating a sustained flow of current through an external load resistor. Procedures for preparing this material and experimental data on its catalytic and electronic properties are presented. 14 refs., 6 figs.

46490 **(CONF-880521—2) Dispersion and holdup in a three-phase fluidized-bed bioreactor.** Davison, B.H. (Oak Ridge National Lab., TN (USA)). 1988. Contract AC05-84OR21400. 18p. NTIS, PC A03/MF A01; 1; GPO Dep. Order Number DE88012941/JAW.

From 10. symposium on biotechnology for fuels and chemicals; Gatlinburg, TN, USA (16 May 1988).

Axial dispersion and phase holdup measurements were made using electroconductivity in a fermenting fluidized-bed bioreactor (FBR) and in a model nonfermenting three-phase FBR. Multiple axial conductivity probes were used to nonintrusively monitor the bed conductivity. The gas phase holdup was estimated from a ratio of the average bed conductivity and bulk conductivity. The solid fraction in the three-phase FBR can be estimated from the two-phase liquid-solid FBR. The response to a salt pulse was used to estimate the liquid axial dispersion coefficient. Particle Peclet numbers on the order of 10/sup {minus}2/ were estimated as a function of flow rates and compared to literature correlations. 10 refs., 7 figs.

46491 **(DOE/ER/13715—1) Bioconversion technology at the Oregon Graduate Center, 2nd year.** Gold, M.H. (Oregon Graduate Center, Beaverton (USA). Dept. of Chemical and Biological Sciences). 27 Apr 1988. Contract FG06-87ER13715. 23p. NTIS, PC A03/MF A01; 1; GPO Dep. Order Number DE88012980/JAW.

In the future biomass technologies should prove to be among the most economically feasible developments of large-scale biotechnology. There is enormous potential for the production of fuels, chemicals and other materials from renewable biomass resources utilizing advanced technologies in biochemistry, genetics and bioengineering. During the past year, OGC has utilized congressionally mandated funds administered by the Office of Basic Energy Sciences of the US Department of Energy to initiate a program in Bioconversion Technology. This document describes biomass research and constitutes a proposal for the second year of support for this program.

46492 **(ENEA-RT-FARE—87-9) Degradation and failure diagnostic techniques of large photovoltaic field modules.** Coscia, U.; Sarno, A. (ENEA, Rome (Italy)). Dec 1987. 24p. (In Italian). NTIS (US Sales Only), PC A03/MF A01. Order Number DE88754224/JAW.

A technique to detect and localize failed modules in a large photovoltaic field is proposed. This technique also allows the measurement of module degradation. The method has been successfully applied to the DELPHOS photovoltaic field.

46493 **(EUR—10854) Photovoltaic activities at the Joint Research Centre, Ispra: A review of results, achievements and plans.** Starr, M.R.; Krebs, K. (Commission of the European Communities, Ispra (Italy). Joint Research Centre). 1988. 441p. NTIS (US Sales Only), PC A19. Order Number DE88012627/JAW.

This book reviews and evaluates the various activities carried out in the field of solar photovoltaics by the Commission of the European Communities Joint Research Centre, Ispra Establishment, Italy, since the time preliminary studies started in 1973. A comprehensive review of the status and outlook for photovoltaics follows this introductory chapter. Subsequent chapters describe the work completed or in progress and summaries are given of the results obtained. The main achievements of the program are identified, focusing on the benefits to the European Community in general and the photovoltaic industry in particular. Special consideration is given to the future role of the JRC with regard to the testing and monitoring of photovoltaic devices and systems and the dissemination of information. A number of recommendations are made regarding the activities to be pursued in future. 40 refs., 137 figs., 27 tabs.

46494 (PNL-SA—15217, pp 111-131) **Comparative analysis of biomass pyrolysis condensates.** Elliott, D.C. 1987. NTIS, PC A99/MF A01. Order Number DE88007332/JAW. (CONF-851027—).

From 24. Hanford life sciences symposium and environmental research on complex organic mixtures; Richland, WA, USA (20 Oct 1985).

The thermochemical conversion of biomass into fuel gases and liquids is one renewable source of fuels that can be substituted for progressively diminishing fossil resources. Under US Department of Energy sponsorship, the technology for high-temperature biomass conversion, primarily by pyrolytic methods, is being developed. It is therefore imperative to understand the chemical, physical, and biological properties of biomass pyrolysis condensate streams. The authors research is aimed at analyzing both aqueous and tar condensates from up-draft, downdraft and fluidized-bed gasifiers as well as entrained-flow pyrolytic liquefaction process units. Sufficient chemical and engineering information has been generated to postulate a theory that can relate the effect of reactor conditions (residence time, temperature and pressure) to the composition of the condensable organic components recovered from the reactor. This paper discusses the theory and its analytical basis, including a summary of the results from analysis of biomass pyrolysates. Analytical results include elemental analysis, chemical functional analysis, specific component identification, physical property measurement (such as viscosity and density) and initial biological testing, including Ames assays and mammalian-cell carcinogenicity assays.

46495 **(SAND—88-7026) Studies in advanced silicon solar cells.** Swanson, R.M. (Stanford Univ., CA (USA)). Jun 1988. Contract AC04-76DP00789. 116p. NTIS, PC A06/MF A01; 1; GPO Dep. Order Number DE88013143/JAW.

This report addresses several issues of interest for the design and fabrication of silicon solar cells. The report begins with a theoretical study concerning the necessity for using more complex mobility models in order to accurately describe the operation of concentrator solar cells. The report then details a modeling and experimental study of recombination under high-level-injection conditions in order to more precisely understand this effect, which will limit cell performance. Becoming more technological, the next section studies the trade-offs between light-trapping and minimization of surface recombination for a variety of texturization schedules. Finally, a study on minimizing surface recombination by optimizing the oxidation parameters is given. The overall utility of the information presented in this document is twofold. First, the mobility, recombination and texturization studies are relevant to improved modeling, prediction, and cell design. Second, the experimental techniques and results are carefully described in order to be useful in the process design and technological optimization of silicon solar cells. 52 refs., 23 figs., 5 tabs.

46496 **(SERI/STR—211-3332) Optimization of transparent and reflecting electrodes for amorphous silicon solar cells: Final subcontract report, 1 October 1986-31 November 1987.** Gordon, R.G.; Proscia, J.; Gustin, K.; Chapple-Sokol, J.; Strickler, D.; McCurdy, R. (Solar Energy Research Inst., Golden, CO (USA); Harvard Univ., Cambridge, MA (USA). Dept. of Chemistry). Jun 1988. Contract AC02-83CH10093. 72p. NTIS, PC A04. Order Number DE88001175/JAW.

In this research, hydrogenated amorphous silicon (a-Si:H) films were deposited by an inexpensive, thermally induced, atmospheric-pressure chemical vapor deposition (CVD) process. High-quality films were grown at 300 A{angstrom}/s, more than two orders of magnitude faster than those produced by conventional glow discharge. Sources of uncontrolled oxygen, boron, phosphorus, and carbon contamination were identified and eliminated. The efficiency of a-Si solar cells can be increased by using rough, rather than smooth, tin oxide as the front-surface transparent electrode, because the rough tin oxide-silicon interface increases the absorption of red light (light trapping) and reduces the reflection loss of light across the whole spectrum. We produced, by CVD, rough tin oxide films from tetramethyltin. Cells grown on the rough films have higher efficiencies than those grown on smooth tin oxide. We also used a precursor tin compound (dimethyltin dichloride) that is less costly and less hazardous than others. Rough films can be grown from dimethyltin dichloride more than three times faster than from tetramethyltin. To combine the CVD processes we need a layer that prevents the tin oxide layer from being attacked by the silicon, such as a barrier layer of titanium oxide, which seems to be effective. 8 refs., 19 figs., 1 tab.

1406 Photovoltaic Power Systems

46497 (N—88-22935) Integrated and modular digital modeling approach for the space station electrical power system development. Gombos, F.J.; Dravid, N. (National Aeronautics and Space Administration, Cleveland, OH (USA). Lewis Research Center). 1988. 9p. (NASA-TM—100904; E—4155; NAS—1.15:100904; CONF-880702—). NTIS, PC A02/MF A01.

From 23. intersociety energy conversion engineering conference; Denver, CO, USA (31 Jul 1988).

An electrical power system for the Space Station was designed, developed and built. This system provides for electrical power generation, conditioning, storage, and distribution. The initial configuration uses photovoltaic power generation. The power system control is based on a hierarchical architecture to support the requirements of automation. In the preliminary design and technology development phase of the program, various modeling techniques and software tools were evaluated for the purpose of meeting the Space Station power system modeling requirements. Rocketdyne and LeRC jointly selected the EASY5 simulation software, developed by Boeing Computer Services, as a system level modeling tool. The application of the selected analytical modeling approach to represent the entire power system is described. Typical results of model predictions are also summarized. The equipment modeled includes solar arrays, dc to ac converters, resonant inverters, battery storage system, alternator, transmission line, switch gear, and system level microprocessor controls. During the advanced development phase of this program, several models were developed using this approach.

46498 (N—88-23197) Comparison of electrically driven lasers for space power transmission. Deyoung, R.J.; Lee, J.H.; Williams, M.D.; Schuster, G.; Conway, E.J. (National Aeronautics and Space Administration, Hampton, VA (USA). Langley Research Center). 1988. 21p. (NASA-TM—4045; L—16431; NAS—1.15:4045). NTIS, PC A03/MF A01.

High-power lasers in space could provide power for a variety of future missions such as spacecraft electric power requirements and laser propulsion. This study investigates four electrically pumped laser systems, all scaled to 1-MW laser output, that could provide power to spacecraft. The four laser systems are krypton fluoride, copper vapor, laser diode array, and carbon dioxide. Each system was powered by a large solar photovoltaic array which, in turn, provided power for the appropriate laser power conditioning subsystem. Each system was block-diagrammed, and the power and efficiency were found for each subsystem block component. The copper vapor system had the lowest system efficiency (6 percent). The CO_2 laser was found to be the most readily scalable but has the disadvantage of long laser wavelength.

46499 (PNL—6582) Photovoltaic industry: Progress from 1980 through 1987. Watts, R.L.; Smith, S.A. (Pacific Northwest Lab., Richland, WA (USA)). Jul 1988. Contract AC06-76RL01830. 24p. NTIS, PC A03/MF A01; 1; GPO Dep. Order Number DE88012849/JAW.

The objective of this report is to summarize photovoltaic (PV) industry developments through 1987. Information is presented on a regional basis (United States, Europe, Japan, other) to avoid disclosing company confidential data. Information was gleaned from several sources, including a review of technical literature and direct contacts with many PV manufacturers. Before the regional totals were published, all numbers were compared with those from other sources published in the United States and those supplied by Japanese industry through their solar energy organization. The information in this report is prepared for use by the US Department of Energy (DOE) in long-range planning activities. However, this information should also be of interest to PV manufacturers and those who may be contemplating entry into the PV market. This report is divided into four chapters. Chapter 2.0 summarizes PV shipments for 1987. Chapter 3.0 presents technology trends and Chapter 4.0 presents trends in the market sectors receiving PV shipments. 12 figs., 10 tabs.

46500 (SAND—87-1769C) The photovoltaic advanced systems test facility. Chamberlin, J.L. (Sandia National Labs., Albuquerque, NM (USA)). 1988. Contract AC04-76DP00789. 7p. (CONF-880513—2). NTIS, PC A02/MF A01; GPO Dep. Order Number DE88009589/JAW.

From 8. European photovoltaic solar energy conference; Florence, Italy (9 May 1988).

Sandia National Laboratories, as part of the United States Department of Energy's (DOE) National Photovoltaics (PV) Program, operates an extensive PV testing laboratory in Albuquerque, New Mexico. The objectives of this laboratory, the Photovoltaic Advanced Systems Test Facility (PASTF), are to assess the performance of PV and balance-of-systems (BOS) hardware and to work with their developers to rectify any performance deficiencies found. The principal resources of the PASTF consist of a materials testing laboratory, a lens and lens/cell testing facility, a module testing facility, an array testing facility, a power conditioner evaluation facility, and specialized test stations for evaluation of BOS hardware. A cell characterization laboratory that is part of the larger Sandia PV effort provides evaluational support in this area. These resources are augmented by Sandia's extensive research and support facilities, principally in the areas of material characterization and environmental testing. The paper describes the resources of the PASTF along with examples of their application to the evaluation of PV hardware.

1407 Solar Thermal Power Systems

46501 (ENEA-RT-FARE—87-8) Photovoltaic conversion: Technology transfer to developing countries. Tufarelli, C. (ENEA, Rome (Italy)). Nov 1987. 179p. (In Italian). NTIS (US Sales Only), PC A09/MF A01. Order Number DE88754228/JAW.

This topic is tackled first from a general point of view, with reference to the issues of economic growth and the choice of techniques. An economic feasibility case-study is performed in which the transfer of energy capital goods to less developed countries is simulated. The case-study specifically deals with a joint-venture producing photovoltaic modules. The shortcomings of standards evaluating procedures are highlighted and, at the same time, the relative advantages ofjoint-ventures over other forms of financial structures are pin-pointed.

46502 (N—88-22382, pp vp) Structural assessment of a space station solar dynamic heat receiver thermal energy storage canister. Thompson, R.L.; Kerslake, T.W.; Tong, M.T. (Sverdrup Technology, Inc., Cleveland, OH (USA)). May 1988. NTIS, PC A14/MF A01. (NASA-CP—3003-VOL-2; E—3970-VOL-2; NAS—1.55:3003-VOL-2; CONF-8805178—).

From Lewis structures technology symposium; Cleveland, OH, USA (24 May 1988).

The structural performance of a space station thermal energy storage (TES) canister subject to orbital solar flux variation and engine cold start up operating conditions was assessed. The impact of working fluid temperature and salt-void distribution on the canister structure are assessed. Both analytical and experimental studies were conducted to determine the temperature distribution of the canister. Subsequent finite element structural analyses of the canister were performed using both analytically and experimentally obtained temperatures. The Arrhenius creep law was incorporated into the procedure, using secondary creep data for the canister material, Haynes 188 alloy. The predicted cyclic creep strain accumulations at the hot spot were used to assess the structural performance of the canister. In addition, the structural performance of the canister based on the analytically determined temperature was compared with that based on the experimentally measured temperature data.

46503 **(SERI/TR—253-3196) High-temperature solar central receivers for electricity production.** Anderson, J.V.; Weaver, N. (Solar Energy Research Inst., Golden, CO (USA)). Jun 1988. Contract AC02-83CH10093. 72p. NTIS, PC A04/MF A01; 1; GPO Dep. Order Number DE88001171/JAW.

This report documents the results of a study on the technical and economic potential of high-temperature central receiver systems for producing electricity. The study covered three advanced high-temperature (1000{degree}-1400{degree}C) central receiver concepts: the direct absorption receiver, the particle injection receiver, and the volumetric receiver. Each receiver was coupled with an intercooled steam-injected gas turbine engine mounted on the tower. Based on this analysis, the particle injection receiver has cost and performance advantages over the volumetric receiver and the direct absorption receiver for high temperatures. Although uncertainties associated with these systems discourage initiating a major program effort in the near term, several low-level activities were identified that if pursued will substantially reduce the degree of uncertainty and allow a more accurate estimation of the technical viability. 38 refs., 24 figs., 4 tabs.

1409 Solar Thermal Utilization

REFER ALSO TO CITATION(S) 46745, 47193

46504 **(AFME—83-3181) Bioclimatic houses. 1. From computation to design. Mediterranean climate. Rexcoop computer program.** Depecker, P.; Brau, J.; Roux, J.J. (Institut National des Sciences Appliquees (INSA), 69 - Villeurbanne (France)). (Agence Francaise pour la Maitrise de l'Energie, 75 - Paris). 1985. 144p. (In French). NTIS (US Sales Only), PC A07/MF A01. Order Number DE88754210/JAW.

A mathematical model used as a tool to evaluate the thermal performance of buildings is presented and verified. The algorithm used for the computation of all the heat transfers in the building (wall, window, roof...) is described. Simulation are done on a microcomputer, and a hour-by-hour quality notation of the building is calculated that allows comparisons between various architectural options. Various applications examples are given for the Tunis area.

46505 **(DTH-LV-MEDD—186) Two proposals of a solar wall design. A survey based on indoor measurements.** Paludan-Mueller, C. (Danmarks Tekniske Hoejskole, Lyngby. Lab. for Varmeisolering). Oct 1987. 68p. (In Danish). NTIS (US Sales Only), PC A04/MF A01. Order Number DE88754067/JAW.

Two different proposals for design of solar walls have been investigated. One of the solar walls was an unvented Trombe wall for which the transparent insulations material, silica aerogal, was a part of the cover system. As outer cover was used a layer of glass, and the storage was a solid concrete wall. The second solar wall was a vented Trombe wall consisting of two layers of glass in front of an uninsulated cavity wall. Heat transfer took place between the air space in front of the absorber and the cavity in the wall by air circulation through vents at the top and at the bottom of the outer leaf of the wall. The wall was built with headers, thus resembling a typical wall from an existing dwelling. The two solar walls were built with realistic dimensions, and their characteristics were measured in the laboratory's indoor test facility for solar walls. The results of the measurements were compared to the results from theoretical calculations, and a reasonably good agreement was obtained. Finally, computer calculations were carried out in order to predict the yearly energy savings that can be expected when the solar walls are used in new buildings and in existing buildings. 14 refs.

46506 **(DTH-LV-MEDD—188) Advantages of small volume flows in a solar heating system. Measurement of 3 small water heaters.** Furbo, S. (Danmarks Tekniske Hoejskole, Lyngby. Lab. for Varmeisolering). Dec 1987. 64p. (In Danish). NTIS (US Sales Only), PC A04. Order Number DE88754069/JAW.

The thermal performance of three different small solar heating systems for domestic hot water supply has been measured under the same conditons. A pumped reference system with a normal volume flow rate, a pumped system using a low volume flow rate and a thermosyhon system have been tested. The reference system is identical with most of the systems marketed today in Denmark. The pumped system using low flow performs about 20% better than the reference system and about 10% better than the thermosyhon system. Pumped systems using low volume flow rate are therefore attractive, and research and development should be initiated in order to develope optimum designed solar heating systems using a low volume flow rate.

46507 **(ETSU-S—1157-P1) Passive solar design studies for non-domestic buildings. Methodology.** (UKAEA Harwell Lab. Energy Technology Div.; Ove Arup and Partners, London (UK)). 1988. 108p. British Library Document Supply Centre, Boston Spa, Wetherby, West Yorks. LS23 7BQ.

The methodology used in the application of passive solar measures in non-domestic buildings, using the technique of design studies was examined. The broad objectives were to quantify the nature, size and timing of passive solar contribution to the UK fuel economy and to transfer the information to the appropriate people. The potential benefit in the application of passive solar measures lies in the better utilization of free incidental and solar gains. It has been calculated that it is technically and economically possible to use such gains along with improved energy efficiency measures to reduce energy consumption in the UK by some 25% in most existing buildings and by over 50% in new buildings. It is estimated that simple passive solar measures alone applied to non-domestic buildings, could contribute between 1 and 2 Million tonnes coal energy equivalent (Mtce) by the year 2025 and considerably more in the longer term.

1410 Solar Collectors And Concentrators

46508 **(DTH-LV-MEDD—187) Convection-driven hydrophylic solar collector.** Paludan-Mueller, C. (Danmarks Tekniske Hoejskole, Lyngby. Lab. for Varmeisolering). Oct 1987. 63p. (In Danish). NTIS (US Sales Only), PC A04/MF A01. Order Number DE88754068/JAW.

In a "convection-driven hydrophile solar collector" the solar heat is transported from the absorber to the storage without the use of the conventional fluid loop. Instead evaporation from a wet material, placed on the back side of the absorber plate, takes place. The vapour is transferred to a stream of humid air, that circulates between the absorber and the storage due to natural convection. The air stream passes through a layer of insulation, that separates the absorber and the storage, and the vapour condenses on the surface of the storage. The water is caught and it is transported back to the absorber plate by capilalary suction in the wet material. The principle behind the hydrophile solar collector can be used in a unit for heating of the domestic hot water and it can be used in a "passive" solar wall. In the project the hydrophile solar collector has been examined closely. A test model has been constructed for measurements, and the results from the measurements are compared with theoretical calculations. The size of the heat transfer coefficient between the absorber and the storage is of crucial importance, and consequently the determination of this parameter forms and essential part of the investigation. The yearly energy gain from the

solar heating system has been calculated by means of a detailed computer model. The energy gain is calculated in case that the system works as a solar wall and in case that it works as a domestic hot water system. 16 refs.

46509 (N—88-22080) Ray tracing optical analysis of offset solar collector for space station solar dynamic system. Jefferies, K.S. (National Aeronautics and Space Administration, Cleveland, OH (USA). Lewis Research Center). 1988. 20p. (NASA-TM—100853; E—4056; NAS—1.15:100853; CONF-880702—). NTIS, PC A03/MF A01.

From 23. intersociety energy conversion engineering conference; Denver, CO, USA (31 Jul 1988).

OFFSET, a detailed ray tracing computer code, was developed at NASA Lewis Research Center to model the offset solar collector for the Space Station solar dynamic electric power system. This model traces rays from 50 points on the face of the Sun to 10 points on each of the 456 collector facets. The triangular facets are modeled with spherical, parabolic, or toroidal reflective surface contour and surface slope errors. The rays are then traced through the receiver aperture to the walls of the receiver. Images of the collector and of the Sun within the receiver produced by this code provide insight into the collector receiver interface. Flux distribution on the receiver walls, plotted by this code, is improved by a combination of changes to aperture location and receiver tilt angle. Power loss by spillage at the receiver aperture is computed and is considerably reduced by using toroidal facets.

46510 (SAND—88-0093C) Analysis of heat pipe receivers for point-focus solar concentrators. Adkins, D.R. (Sandia National Labs., Albuquerque, NM (USA)). 1988. Contract AC04-76DP00789. 21p. (CONF-880850—3). NTIS, PC A03/MF A01; 1; GPO Dep. Order Number DE88014519/JAW.

From American Institute of Chemical Engineers summer national meeting; Denver, CO, USA (21 Aug 1988).

Heat-pipe solar receivers are used to transfer concentrated solar energy from the focal point of a parabolic dish concentrator to the working fluid of a heat engine (or in some instances a chemical reactor). Concentrated solar energy that is collected on the front (absorber) surface of a heat pipe receiver is removed by the evaporation of an intermediate working fluid on the back side of the absorber surface. The vaporized fluid flows to the heater tubes of an engine where it condenses and transfers energy to the heat engine's working fluid. The condensed vapor then returns to the absorber surface where it is redistributed across the surface by a wick. Heat pipes are an attractive option for coupling solar concentrators to heat engines because of their near isothermal operating characteristics and their ability to transfer large amounts of heat from relatively small surface areas. This paper investigates design factors that must be considered in constructing a solar heat pipe receiver. Particular emphasis is placed on designing a wick structure to transport the working fluid across the solar absorber surface, but general issues concerning fluid flow in heat pipe receivers are also presented. Analytical tools for the design of heat-pipe solar receivers are also provided. 18 refs., 11 figs., 3 tabs.

15 GEOTHERMAL ENERGY

1502 Geology And Hydrology Of Geothermal Systems

46511 (ETSU-G—137-P11) Current status of hot dry rock technology with reference to South West England. (UKAEA Harwell Lab. Energy Technology Div.). 1988. 198p. British Library Document Supply Centre, Boston Spa, Wetherby, West Yorks. LS23 7BQ.

This report has been prepared as a review of the status of Hot Dry Rock (HDR) technology with reference to its further development in South West England. It has been divided into three parts. Part I is concerned with the primary activities: design of the HDR reservoir, and the drilling, stimulation, development and circulation of the reservoir. Part II is concerned with the technology which supports the primary activities, and Part III summarises the findings of the report, and makes recommendations for future work.

1503 Geothermal Exploration And Exploration Technology

REFER ALSO TO CITATION(S) 46511

46512 Development of polycrystalline diamond compact bits for hard rock drilling. Karasawa, H.; Misawa, S.; Rowley, J.C. (National Research Institute for Pollution and Resources, Yatabe, Tsukuba, Ibaraki 305 (JP)). pp 188-197 of Geothermal energy symposium. New York, NY; American Society of Mechanical Engineers (1988). (CONF-880104—).

From 11. annual energy-sources technology conference and exhibition; New Orleans, LA, USA (10 Jan 1988).

To improve the application of polycrystalline diamond compact (PDC) bits to harder formations, the effect of backrake and siderake angles on the performance of PDC bits was studied. Results showed that rake angles have a significant effect on the penetration rate and the cutter strength. Besides, the optimum rake angles depend on rock type. A new PDC cutter was designed and tested. This PDC cutter exhibited higher penetration rate and improved cutter strength relative to the conventional PDC cutter when applied to drilling granite.

1504 Legal And Institutional Aspects

46513 Geothermal Steam Act Amendments of 1987. Hearing before the Subcommittee on Mineral Resources Development and Production of the Committee on Energy and Natural Resources, United States Senate, One Hundredth Congress, First Session on S. 1006, July 14, 1987. Washington, DC; Government Printing Office (1988). 280p.

The US Geological Survey estimates that it has identified recoverable geothermal energy which could be readily used to generate electricity in about 440 quadrillion BTUs, equivalent to about 40 billion barrels of oil. However, there are concerns regarding the impact of geothermal development and significant geothermal features with national parks and monuments. As important as geothermal energy is, we cannot allow it to be developed at the expense of nationally significant features, such as Old Faithful, the geyser basin in Yellowstone National Park. In accordance with Public Law No. 99-591, DOI issues a list of significant thermal features within national parks to be protected against adverse impacts of geothermal leasing. Witnesses here testified as to the adequacy of the list as well as to concerns that geothermal development on private lands may be affecting thermal features within the parks. Witnesses included officials from geothermal development companies, resource companies with geothermal interests, National Parks and Conservation Ass'n., Department of Interior, and US Senators and Congressmen. Appendices include (1) responses to additional committee questions, and (2) additional material submitted for the record.

1509 Geothermal Engineering

46514 (ETSU-G—137-P1) Preliminary report on the construction of a deep prototype HDR geothermal system in Cornwall: drilling and casing aspects. (UKAEA Harwell Lab. Energy Technology Div.). 1988. 183p. British Library Document Supply Centre, Boston Spa, Wetherby, West Yorks. LS23 7BQ.

A preliminary desk study has been carried out to review the technical requirements and likely cost of constructing a deep prototype Hot Dry Rock (HDR) system in Cornwall. The requirements for the drilling and casing programmes for a 6000 m deep directionally drilled HDR doublet well are addressed. Background information on the geology, stress and temperature regime in which the wells would be emplaced if they were located in Cornwall is given. Comment is also included on a 6000 m deep vertical exploration well option in the event that this more modest programme is perceived to be the best next stage for research. Cost estimates for 6000m wells in granite in Cornwall are given.

46515 **(ETSU-G—137-P12) Camborne geothermal energy project. Technical progress review. (1986-1987).** (UKAEA Harwell Lab. Energy Technology Div.). 1988. 129p. British Library Document Supply Centre, Boston Spa, Wetherby, West Yorks. LS23 7BQ.

Progress in the first year (1986-1987) of Phase 2C of the Camborne School of Mines Geothermal Energy Project is reported. Reservoir Characterisation has been a major task, and some changes in the original work programme have been made as a result of a review of the current status of Hot Dry Rock (HDR) technology, and of the findings in this phase. Development of instrumentation for the deep pilot system is progressing, and a number of changes have been made to improve measurement techniques on the Rosemanowes system. Heatflow measurements and modelling, and seismic reflection surveys have been used to improve the definition of the HDR resource in Cornwall. The task of selecting a suitable site for the deep pilot system has begun, with the commissioning of three specialist studies on the geology, environment and infrastructure of Cornwall. The task is ongoing, and will continue until the choice has been narrowed down to a few locations which would seem to satisfy all the relevant criteria.

46516 **Research in lost circulation control for geothermal wells.** Ortega, A.; Loeppke, G.E.; Givler, R.C.; Livesay, B.J. (Fluid Mechanics and Heat Transfer Div. I, Sandia National Labs., Albuquerque, NM (US)). pp 233-242 of Geothermal energy symposium. New York, NY; American Society of Mechanical Engineers (1988). (CONF-880104—).

From 11. annual energy-sources technology conference and exhibition; New Orleans, LA, USA (10 Jan 1988).

This paper reviews recent progress at Sandia National Laboratories in the area of lost circulation control for geothermal wells. The Lost Circulation Program has three major elements: (1) Detection and characterization of loss zones; (2) Development of new techniques and materials for control of loss zones, and (3) Integration of the first two items for wellsite application. Most of our work to date has been in the area of developing new techniques and materials. The authors report here on progress that has been made in the past two years in the development of new, pumpable cementitious muds, in situ mixing and placement of polyurethane foams, and fundamental analysis of and materials development for particulate lost circulation materials. Plans for work in the area of zone detection and characterization, including development of a transient, lost circulation hydraulics simulator a field zone characterization using an advanced wellbore televiewer, are discussed.

1520 Geothermal Data And Theory

REFER ALSO TO CITATION(S) 47431, 47438

16 TIDAL AND WAVE POWER

1608 Wave Energy Converters

46517 **(ETSU-WV—1518-P2) Interim report to the Wave Energy Steering Committee.** (UKAEA Harwell Lab. Energy Technology Div.; Vickers Ltd., Eastleigh (UK). Design and Projects Div.). 1977. 78p. British Library Document Supply Centre, Boston Spa, Wetherby, West Yorks. LS23 7BQ.

The experimental and theoretical work completed during the jointly funded feasibility study on the Vickers submerged resonant duct device is described. Encouraging results and improvement in the mechanism for overtopping are discussed. Future work to investigate a greater range of take-off flow rates and the effect of orientation is recommended.

17 WIND ENERGY

1701 Availability (climatology)

46518 **(ENEA-RT-FARE—87-5) Anemological research in Sardinia.** Proverbio, E.; Quesada, V.; Pirazzi, L. (ENEA, Rome (Italy)). Dec 1987. 112p. (In Italian). NTIS (US Sales Only), PC A06/MF A01. Order Number DE88754226/JAW.

The report describes a survey, carried out by the Astronomical Station of Cagliari, Sardinia, of potential sites for wind turbine installations. Archaeological, military and aesthetical aspects, as well as, geomorphological constraints were considered in this assessment. Four suitable areas for important installations (field test, medium and large machines) were identified according to the methodology described in the text.

1704 Economics

46519 **(DOE/AL/20986—T1) Special research and development/wind energy: Final report, [September 1, 1982-September 30, 1985].** Jackson, W.T. (New Mexico Engineering Research Inst., Albuquerque (USA)). 12 Nov 1985. Contract AC04-82AL20986. 6p. NTIS, PC A02. Order Number DE88013489/JAW.

On September 1, 1982 the New Mexico Engineering Research Institute (NMERI) began work on DOE Contract DE-AC04-82AL20986, entitled {open<-quotes}Special Research and Development/Wind Energy{close<-quotes}. The contract was awarded to provide the Wind Energy Technology Program Office (WETPO) of the DOE Albuquerque Operations office a local research capability to advise on technology assessment and input program planning for the wind energy technology programs under WETPO cognizance. NMERI provided this research support for a period of three years and one month until contract completion on September 30, 1985.

46520 **(ELSAM-Notat-S—86-141-f) Guidelines for system studies under EC wind power penetration study.** (Jysk-Fynske Elsamarbejde (ELSAM), Fredericia (Denmark)). Mar 1987. 86p. NTIS (US Sales Only), PC A05. Order Number DE88754070/JAW.

The EC Wind Power Penetration Study is intended - to evaluate the extent to which windpower can technically and economically be fitted into the power production systems of the member countries. - to identify relevant r and d projects which may facilitate the penetration of wind power in the existing generation systems. In order to - serve as background information in the energy political deliberation of the CJommunity and the national governments - serve as background information for utilities - serve as guidance for wind turbine manufactures' market analyses.

1705 Environmental Aspects

REFER ALSO TO CITATION(S) 46518

1706 Wind Energy Engineering

REFER ALSO TO CITATION(S) 46519, 47198

46521 **(N—88-22408, pp vp) Large-scale wind turbine structures.** Spera, D.A. May 1988. NTIS, PC A16/MF A01. (NASA-CP—3003-VOL-3; E—3970-VOL-3; NAS—1.55:3003-VOL-3; CONF-8805178—).

From Lewis structures technology symposium; Cleveland, OH, USA (24 May 1988).

The purpose of this presentation is to show how structural technology was applied in the design of modern wind turbines, which were recently brought to an advanced stage of development as sources of renewable power. Wind turbine structures present many difficult problems because they are relatively slender and flexible; subject to vibration and aeroelastic instabilities; acted upon

by loads which are often nondeterministic; operated continuously with little maintenance in all weather; and dominated by life-cycle cost considerations. Progress in horizontal-axis wind turbines (HAWT) development was paced by progress in the understanding of structural loads, modeling of structural dynamic response, and designing of innovative structural response. During the past 15 years a series of large HAWTs was developed. This has culminated in the recent completion of the world's largest operating wind turbine, the 3.2 MW Mod-5B power plane installed on the island of Oahu, Hawaii. Some of the applications of structures technology to wind turbine will be illustrated by referring to the Mod-5B design. First, a video overview will be presented to provide familiarization with the Mod-5B project and the important components of the wind turbine system. Next, the structural requirements for large-scale wind turbines will be discussed, emphasizing the difficult fatigue-life requirements. Finally, the procedures used to design the structure will be presented, including the use of the fracture mechanics approach for determining allowable fatigue stresses.

46522 (PB—88-155619/XAB) Search routine for optimization on the power in a wind power plant with variable speed. Bengtsson, P. (Foersvarets Forskningsanstalt, Stockholm (Sweden)). Nov 1987. 108p. (In Swedish). (FOA-C—20681-2.7). NTIS, PC E05/MF A01.

To get a wind power plant with variable speed to deliver maximum power at actual windspeed it is important that the speed of the turbine is correct. The paper describes a method how to obtain this, by optimization of a parameter of amplification, KQ, in the electrical control of the power plant. A model of the wind power plant and the optimizing algorithm have been designed and implemented in the simulation language Simnon. The optimization algorithm works in the following way. Add a test signal to KQ so that a power variation is obtained. Estimate the cross-covariance between the test signal and the power variation. The result of the estimation is then used to adjust KQ to its optimum.

20 ELECTRIC POWER ENGINEERING

2001 Power Plants And Power Generation

REFER ALSO TO CITATION(S) 46278, 46571

46523 (EPRI-AP—5887) Investigation of specific combustion turbine and combined-cycle field problems: Compressor blade migration: Final report. Smalley, A.J.; Simmons, H.R. (Electric Power Research Inst., Palo Alto, CA (USA); Southwest Research Inst., San Antonio, TX (USA)). Jun 1988. 71p. Research Reports Center, Box 50490, Palo Alto, CA 94303. Order Number TI88012773/JAW.

This report documents the phenomenon of compressor blade migration, commonly referred to as "blade walking:. It presents statistical data on over 50 past occurrences of blade walking, on the nature of the occurrences, and on their consequences. The report provides some of the manufacturer's rationale for blade walking, and describes the processes of thermal distortion on turning gear which can cause blade tip rubs, locking pin breakage, and subsequent blade walking. The report further documents manufacturer's recommendations, which have been provided to avoid the problem, or to mitigate consequences of the problem should it occur. The report goes on to discuss the state of knowledge on the subject and to identify information which would improve understanding, but which is at present missing, or incomplete. The report concludes with a test plan designed to quantify transient thermal distortion on turning gear following shutdown; the benefits of short term spin cooling on thermal distortion; and the influence of turning gear operation on startup vibration. 9 refs., 20 figs., 8 tabs.

46524 (EPRI-CS—5754-Vol.3) Guidelines for cofiring refuse-derived fuel in electric utility boilers: Volume 3, Appendixes: Final report. Fiscus, D.E. (Electric Power Research Inst., Palo Alto, CA (USA); Midwest Research Inst., Kansas City, MO (USA)). Jun 1988. 146p. Research Reports Center, Box 50490, Palo Alto, CA 94303. Order Number TI88013638/JAW.

The guidelines presented in Volumes 1 and 2 address the procedures for evaluating proposed RDF (refuse derived fuel) cofiring projects, RDF specification and preparation, impact of RDF cofiring on power plant performance and operation, design criteria for RDF handling and other equipment, environmental control systems, capital and O and M cost estimates, economic analysis, and the breakeven RDF value to the utility. The appendices in Volume 3 contain supplemental design, performance and cost data for RDF preparation and cofiring facilities. 1 ref., 19 figs., 52 tabs.

46525 (EPRI-CS—5873) Instrumentation handbook for integrated power plant water management: Final report. Irani, M.T.; Geist, R.D.; Murphy, R. (Electric Power Research Inst., Palo Alto, CA (USA); CH2M Hill, Bellevue, WA (USA); Resources Conservation Co., Bellevue, WA (USA)). Jul 1988. 339p. Research Reports Center, Box 50490, Palo Alto, CA 94303. Order Number TI88013636/JAW.

Diminishing water resources and stringent environmental regulations are strong motivations for power plants to incorporate well-defined and closely monitoring instruments can greatly aid in this effort. A handbook discussing the primary measuring elements normally used in an integrated water management system has been developed. This handbook includes a section on typical power plant water management systems, as well as separate sections on various primary elements used for measuring flow, level, density, temperature, pressure, and certain physical and chemical parameters. Published literature and information provided by instrument manufactures were compiled and summarized for each primary element under the following topics: principle of operation, typical application, stream compatibility, performance characteristics, indication and transmission, installation requirements, maintenance and calibration, and specification requirements. As a result, this handbook provides power industry engineering and operating personnel with a generic guide for selecting, installing, calibrating and maintaining primary measuring elements for integrated water management systems.

46526 (EPRI-CS—5903) Influence of generic chemical additives on cooling-system performance: Final report. Dabiri, A.E.; Mertol, A.; Ghiaasiaan, S.M.; Goodman, J. (Electric Power Research Inst., Palo Alto, CA (USA); Science Applications International Corp., Los Altos, CA (USA)). Jul 1988. 152p. Research Reports Center, Box 50490, Palo Alto, CA 94303. Order Number TI88013633/JAW.

Chemical additives are frequently used in recirculated cooling water systems to maintain heat transfer performance by preventing condenser tube scaling and corrosion. However, some of these same additives have also been suspected of potentially degrading cooling system performance either by decreasing the heat transfer film coefficient at the inner surface of the condenser tube or by reducing evaporation in the cooling tower. This report presents the results of a comprehensive literature search and subsequent theoretical evaluation of the influence of generic chemical additives on cooling system performance. Results indicate that, at the concentrations used in power plant cooling systems, additives have no significant detrimental effect on heat transfer in condenser tubes. In cooling towers, certain additives may act as a surfactant and suppress the hydrodynamic waves at the gas-liquid interface for a falling film of water. However, the additives do not change the film thermophysical properties, and, therefore, do not reduce the vapor pressure of the liquid at the surface, which is the driving force for evaporation.

46527 (EPRI-NP—5924) Surveillance, monitoring, and diagnostic techniques to improve diesel generator reliability: Final report. Driscoll, G.D.; Oelkers, E.; Pickett, A.G.; Redfield, J.B. (Electric Power Research Inst., Palo Alto, CA (USA); Southwest Research Inst., San Antonio, TX (USA)). Jul 1988. 164p. Research Reports Center, Box 50490, Palo Alto, CA 94303. Order Number TI88013637/JAW.

EPRI's project on "Surveillance, monitoring and diagnostic techniques to improve diesel generator reliability" (Research Project 2235-1) sought to identify on-line monitoring and diagnostic instrumentation and techniques that could be applied to nuclear

power plant diesel generators. The goal was to assist operators and maintenance personnel in improving the reliability of these systems. The project started with an investigation of operating experience of the diesel generators for the purpose of identifying failures. The results organized the failures by diesel generator system and subsystem and delineated the numbers and kinds attributed to each. The best approach for correcting each of the failures was then considered in view of recommendations from utilities, DG manufactures and other users of these systems. The approaches considered were: design changes, changes in operating procedures, changes in maintenance and inspection procedures, and the application of on-line monitoring and diagnostics. A survey of commercially available monitoring and diagnostic equipment and systems was conducted and summarized. An actual utility installation was chosen to serve as a basis for a detailed scoping design of a conceptual monitoring and diagnostic system. Monitoring and diagnostic hardware (including transducers, signal conditioners, an intelligent front end, and a master computer system) were specified and their requirements and functions defined based on the results of the failures experience findings. According to need, a utility can select from the comprehensive package of monitoring and diagnostic features and hardware that are delineated. 12 figs., 10 tabs.

2002 Environmental Control Technology

REFER ALSO TO CITATION(S) 46256, 47343

46528 (CONF-870436—2) A trace metal study surrounding a coal-fired electrical generating facility. Mitchell, D.L.; Wilson, B.L. (Texas Southern Univ., Houston (USA). Dept. of Chemistry). 1987. Contract FG02-86CH10255. 31p. NTIS, PC A03/MF A01; 1; GPO Dep. Order Number DE88014918/JAW.

From 14. annual national organization for professional advancement of black chemists and chemical engineers; San Francisco, CA, USA (13 Apr 1987).

There are approximately 1300 coal-fired facilities that generate more than 55% of the nation's electricity. State-of-the-art technology removes 99% of the particulates in coal and 97% of the SO_2. That kind of efficiency appears to be more than adequate until one realizes that the coal consumption of some power generating facilities may exceed 15,000 tons/day. Hence, it becomes very obvious of the potential anthropogenic effects of a daily release of pollutants to the environment via stack gases, fine metallic aerosols which elude modern pollution control equipment, and fly ash. The aqueous sediments of several lakes surrounding a coal-fired electric generating facility in southwest Houston are analyzed for trace metals by atomic absorption spectroscopy. Twenty to twenty-five centimeter cores are treated and analyzed for carbon content, sediment size, and trace metal concentration. A higher concentration appears to be present in the top portion of some cores which suggests that there has been some contribution to the aqueous sediment due to the recent industrialization of southwest Houston. Some of the elements of concern in this study are known to have a carcinogenic and/or mutagenic effect on man such as Hg, Pb, V, and Zn. Furthermore, the significance of this study is immeasurable in that it establishes background data that is critical in substantiating any claims of future additions and in preventing any potential health hazards in lake and stream eutrophication. 17 refs., 1 fig., 8 tabs.

46529 (DOE/PC/60425—T1) A chemical thermodynamics data program for SO/sub x/-NO/sub x/ removal systems: [Progress report], 1 September 1983-30 March 1986. Garvin, D. (National Bureau of Standards, Washington, DC (USA). Chemical Thermodynamics Div.). 20 May 1986. Contract AI22-83PC60425. 17p. NTIS, PC A03/MF A01; 1; GPO Dep. Order Number DE88003823/JAW.

This progress report summarizes the activities at the National Bureau of Standards to provide a data base of quantitative chemical thermodynamic information for use in SO/sub x/-NO/sub x/ systems. (a) A preliminary survey was made of reports on SO/sub x/-NO/sub x/ processes to identify the chemistry in them and the operating conditions. One hundred fifteen substances were identified, one third of which were not SO/sub x/, NO/sub x/ or sulfur-nitrogen compounds. (b) A data base was assembled on measurements of the thermochemistry of compounds in, or closely related to, the SO/sub x/ system. Included are sulfur species, sulfur-oxygen, sulfur-hydrogen, sulfur-oxygen-hydrogen compounds, plus a few sulfur-halogen compounds that may be of interest, either in practice or for the evaluation of other data. Some 650 measurements were identified and the data in 600 of them analyzed. (c) The thermodynamic properties of aqueous solutions of SO_2 were evaluated. (d) A data base of activity coefficients in aqueous solutions. (e) A study was started of the availability of thermodynamic data needed to describe practical SO/sub x/-NO/sub x/ systems, with a view to identifying needed measurements. (f) The evaluation of measurements pertinent to the SO/sub x/ data base was completed. (g) The analysis of the SO_2-H_2O system was completed. (h) The activity coefficent data system was completed and tested. (i) A database of thermochemical measurements on the NOx system.

46530 (EUR—11402) The demonstration of improved cyclonic particulate removal equipment for use with coal-fired industrial boiler plant: Demonstration project: Final report, October 1987. (Commission of the European Communities, Luxembourg; British Coal Corp., Stoke Orchard. Coal Research Establishment). 1988. 65p. NTIS (US Sales Only), PC A04; 1; GPO Dep. Order Number DE88014227/JAW.

This document reports the work undertaken, under Contract No. EEC/100/83/UK, to demonstrate, at industrial scale, improved designs of inertial separators for use with coal-fired boiler plant. These separators, developed at University College, Cardiff [UCC] and called Cardiff cyclones incorporate a novel aspect in cyclone design known as the vortex collector pocket [VCP]. At laboratory scale these cyclones had shown improved separation performance compared with cyclones of conventional design [Stairmand High Efficiency]. Further they promised a lower tendency towards metal wastage, a problem common in conventional designs. Three Cardiff cyclone variants were demonstrated during the contract period June 1984--May 1987. Each unit successfully controlled the particulate emissions from their respective boiler plant to well below that required by the UK Clean Air Act. However, in each case their performance in terms of particle grade collection efficiency fell short of that predicted from scale-up of laboratory test data. But each demonstration cyclone showed flexibility in operation by maintaining its optimum separation performance over an extended range of gas throughputs. Information obtained during extensive studies on laboratory and intermediate scale cyclones resulted in only limited improvements when applied to the full scale demonstration cyclones. These studies further suggested that the normal Stokes scaling criteria used to design larger units is of only limited use when applied to this novel design. 28 refs., 31 figs., 15 tabs.

2003 Power Transmission And Distribution

46531 (N—88-22939) Application of high temperature superconductors to space electrical power distribution components. Aron, P.R.; Myers, I.T. (National Aeronautics and Space Administration, Cleveland, OH (USA). Lewis Research Center). 1988. 8p. (NASA-TM—100901; E—4153; NAS—1.15:100901; CONF-880702—). NTIS, PC A02/MF A01.

From 23. intersociety energy conversion engineering conference; Denver, CO, USA (31 Jul 1988).

Some important space based electrical power distribution systems and components are examined to determine what might be achieved with the introduction of high temperature superconductors (HTS). Components that are compared in a before and after fashion include transformers, transmission lines, and capacitors. It is concluded that HTS has its greatest effect on the weight associated with transmission lines, where the weight penalty could be reduced by as much as 130 kg/kW/km of cable. Transformers, because 28 percent of their mass is in the conductor, are reduced in weight by the same factor. Capacitors are helped the least with only negligible savings possible. Finally, because HTS can relax the requirement to use alternating current in order to reduce conductor mass, it will be possible to generate significant savings by eliminating most transformers and capacitors.

21 NUCLEAR POWER PLANTS

REFER ALSO TO CITATION(S) 46593, 46659, 47146

2101 Power Reactors, Non-breeding, Light-water Moderated, Boiling Water Cooled

REFER ALSO TO CITATION(S) 46607, 46611, 46645, 46647, 46630, 46654, 46662, 46670, 46888, 47667

46532 (EPRI-NP—5882M) Stress corrosion cracking resistance of alloys 600 and 690 and compatible weld metals in BWRs: Final report. Page, R. A.; McMinn, A. (Electric Power Research Inst., Palo Alto, CA (USA); Southwest Research Inst., San Antonio, TX (USA)). Jul 1988. 54p. Unlimited audience, publicly available. Research Reports Center, Box 50490, Palo Alto, CA 94303. Order Number TI88014887/JAW.

The relative susceptibilities of alloy 600 and 690 base metals and I-82, I-182, R-127 and R-135 weld metals to intergranular stress corrosion cracking (IGSCC) in either pure water or a simulated resin intrusion environment at 288{degree}C were evaluated. Alloy 600, I-182, and I-82 weld metals were susceptible to various degrees of IGSCC in oxygen containing pure water when creviced, and immune to IGSCC when uncreviced. Alloy 690 was immune to IGSCC under all pure water conditions. Alloy 500, alloy 690, I-182, and I-82 were all susceptible to cracking in the simulated resin intrusion environment, although alloy 690 exhibited the greatest resistance to SCC. The high chromium experimental weld alloy were immune to cracking under all conditions examined. The IGSCC susceptibility of seven different weld metals used to weld alloy 600 and A508 were also evaluated in the resin intrusion environment at 288{degree}C. Weldments made with I-625, I-182, and I-82 (GTAW) were the most susceptible, whereas welds made with I-132 were the least susceptible. Most of the weldments failed at the fusion line between the weld metal and the A508 steel, and the SCC susceptibility increased with increasing hardness measured at the fusion line. There was no effect of crevice condition or heat treatment on SCC susceptibility. The SCC susceptibility of Type 316 NG stainless steel welded with R-127, R-135, I-72 and Type 308L weld metals was evaluated in pure water and resin intrusion environments at 288{degree}C. All of the materials were immune to SCC in the pure water environment. In the resin intrusion environment, both the I-72 and R-135 weld metals were immune to SACC, but the R-127 and Type 308L weld metals exhibited SCC. The Type 316 NG stainless steel was susceptible to transgranular SCC in the resin intrusion environment, except when welded with I-72, in which case it was immune. 36 refs., 4 tabs.

46533 Evaluation of new fuel designs - a TVA perspective. Taylor, O.W.; Robert, J.T. (Tennessee Valley Authority, Chattanooga (USA)). *Transactions of the American Nuclear Society;* **55**: 106-107(1987). (CONF-8711195—).

From American Nuclear Society winter meeting; Los Angeles, CA, USA (15 Nov 1987).

The Tennessee Valley Authority (TVA) performs detailed economic and technical evaluations of proposed new or improved fuel designs to determine the feasibility of their utilization in TVA's nuclear units. These evaluations are performed to ensure that fuel designs selected for use in TVA's units are safe, reliable, and economical.

46534 Water chemistry and corrosion control. Jonas, O. *Transactions of the American Nuclear Society;* **55**: 251-252(1987). (CONF-8711195—).

From American Nuclear Society winter meeting; Los Angeles, CA, USA (15 Nov 1987).

The purpose of this paper is to propose a formalized system approach and application of chemical thermodynamic and kinetic and corrosion data for design and operation of advanced light water reactors. Based on past experience and corrosion and chemical principles, a checklist for corrosion resistant design is proposed. According to the checklist, cycle chemical transport will be determined and all critical surfaces of major water and steam cycle components would be evaluated for local concentrations of water treatment chemicals and impurities, pH, and corrosion potential; effects of these in situ environments on general and localized corrosion and erosion-corrosion (effects of flow) will be evaluated. In addition, in this formalized approach, transport, deposition, and removal of corrosion products will be predicted and water chemistry and corrosion monitoring outlined. All the above evaluations can be repeated during the cycle design phase for various types of water chemistry control, which are now being used or are being developed. A flow chart for the proposed corrosion-resistant design approach is shown.

46535 Aspects of zircaloy core materials for advanced LWRs. Adamson, R.B.; Cheng, B.C.; Tucker, R.P. *Transactions of the American Nuclear Society;* **55**: 254-255(1987). (CONF-8711195—).

From American Nuclear Society winter meeting; Los Angeles, CA, USA (15 Nov 1987).

Zircaloy has been successfully used as the primary light water reactor (LWR) core structural material since its introduction in the early days of the US naval nuclear program. Its unique combination of low neutron absorption cross section, fabricability, mechanical strength, and corrosion resistance in high-temperature water has resulted in remarkable reliability of operation of pressurized and boiling water reactor (PWR, BWR) fuel through the years. Currently, BWRs use Zircaloy-2 for fuel cladding and Zircaloy-4 for channels and spacers, while PWRs use Zircaloy-4 for fuel cladding, spacer grids, and control rod guide tubes. As required fluences continue to increase and as a more statistically significant number of components reach ultra-high burnups, however, Zircaloy as a material is liable to be pushed to its operating limits. This paper discusses those areas to which fuel vendors are giving attention; e.g., microstructure, corrosion, irradiation growth and creep, and mechanical properties.

46536 Advances in light water reactor fuels. Franklin, D.; Noble, D.; Machiels, A.; Ozer, O.; Yang, R. *Transactions of the American Nuclear Society;* **55**: 255-257(1987). (CONF-8711195—).

From American Nuclear Society winter meeting; Los Angeles, CA, USA (15 Nov 1987).

Since nuclear fuel must be periodically replaced as it is depleted, many improvements can be incorporated into the design of the fuel without requiring modifications in existing plants. This results in a continuing development, demonstration, and application process so that the fuel design for the next generation of light water reactors (LWRs) can be expected to be similar to the one used in today's LWRs. The Electric Power Research Institute's advanced LWR requirements document reflects this by specifying fuel requirements that are very close to the current US utility requirements, including a reflection of the trend to high burnup and to 24-month cycles. Therefore, the following discussion addresses general advances in fuel design rather than specifically addressing designs for future LWRs. The scope of the discussion on fuel design covers the fuel assembly as a whole as well as its individual parts, with the exception of metallurgical advances in Zircaloy. The objectives of design changes are to improve safety, reliability, and fuel-cycle economics, usually in that order of priorities.

46537 NRC research in aging and extended life for LWR primary systems. Serpan, C.Z. Jr. *Transactions of the American Nuclear Society;* **55**: 266-267(1987). (CONF-8711195—).

From American Nuclear Society winter meeting; Los Angeles, CA, USA (15 Nov 1987).

The US Nuclear Regulatory Commission (NRC) research program on the integrity of materials and components for light water reactor (LWR) primary systems has always had a primary objective of identifying and evaluating issues that could affect the safety of operating nuclear power plants. Studies to date have focused on safety assurance for regulation during the original 40-yr license period. As some of these earliest licenses begin to approach their end, both NRC and the industry are attempting to detect and evaluate issues that may impact on safe and reliable life for an additional operating period of up to 40 yr. The NRC expects to receive the first application for plant life extension in 1992; thus, the technical issues of critical importance for regulatory review must be identified and an adequate, independent basis established by then. Neu-

tron-induced embrittlement of the reactor vessel irradiation effects to core structural elements. An issue that bridges both vessels and piping is that of the fatigue life, as currently described in Section III of the American Society of Mechanical Engineers (ASME) Boiler and Pressure Vessel Code, toughness decrease in cast stainless steel due to aging at service temperature, water chemistry, and nondestructive examination are issues that affect aging and life extension discussed in the paper.

46538 **Fatigue damage in major light water reactor components.** Shah, V.N.; Server, W.L. *Transactions of the American Nuclear Society;* **55**: 270-272(1987). (CONF-8711195—).

From American Nuclear Society winter meeting; Los Angeles, CA, USA (15 Nov 1987).

The US Nuclear Regulatory Commission (NRC) is sponsoring a Nuclear Plant Aging Research (NPAR) program for resolution of technical safety issues associated with aging of, and license renewal for, commercial nuclear power plants. One project in the NPAR program is to develop the appropriate technical procedures and criteria for the NRC to assess the residual life of the major light water reactor components and structures. These assessments will help the NRC resolve certain safety issues and develop policies and guidelines for marking timely license-renewal decisions. Most of the effort for this residual life assessment project is focused on integrating, evaluating, and updating the technical information relevant to aging and license renewal from current and completed NRC and industry research programs. The major components for this project were selected according to the role they play in containing any fission products that may be released during an accident. The selected components include primary pressure boundary components, primary containments, cables and connectors, emergency diesel generators, and reactor pressure vessel supports. The degradation sites, mechanisms, stressors, and potential failure modes for these major components have been identified and evaluated. The results show that fatigue is a major degradation mechanism acting at several critical locations. This paper reviews the fatigue damage in the major components and identifies the unresolved safety issues relevant to aging and license-renewal considerations.

46539 **Benchmarking and modification of FRAPCON2 V1MOD5.** Lindquist, K.O.; Hsieh, S.T.C.; Haley, T.C. *Transactions of the American Nuclear Society;* **55**: 287-289(1987). (CONF-8711195—).

From American Nuclear Society winter meeting; Los Angeles, CA, USA (15 Nov 1987).

The FRAPCON2 V1MOD5 computer program has been benchmarked against precharacterized fuel rods from irradiation surveillance programs of commercial pressurized water reactor (PWR) and boiling water reactor (BWR) fuel types as well as instrumented test rods irradiated at Halden. Five 15 x 15 PWR rods from assembly C64 irradiated for five cycles in Zion 1 and 2 were analyzed. After five cycles of irradiation, these rods had accumulated ~ 60 GWd/tonne uranium peak local exposure. Three 8 x 8 BWR fuel rods from bundle MTB099 irradiated at Monticello, as well as two 8 x 8R BWR rods from the Peach Bottom lead test assembly program, were also analyzed. These rods achieved peak local exposures of 55 and 41 GWd/tonne uranium, respectively, at discharge. The FRAPCON2 V1MOD5 predictions were compared with fuel profilometry, oxide film thickness, fission gas release, fuel swelling, and other parameters measured either at the end of each fuel cycle or in hot cell examinations. In addition, 17 instrumented rods from IFA 429, 431, and 432 irradiated in the Halden reactor were examined to provide comparisons of predicted versus measured fuel temperatures and fission gas release. It has been demonstrated that FRAPCON2 V1MOD5, with the modifications described, provides a best-estimate calculation of fuel thermal mechanical behavior for current PWR and BWR fuel types.

46540 **Results from ultrasonic measurements of failed fuel rods.** Snyder, B.J. *Transactions of the American Nuclear Society;* **55**: 289-290(1987). (CONF-8711195—).

From American Nuclear Society winter meeting; Los Angeles, CA, USA (15 Nov 1987).

The failed fuel rod detection system (FFRDS) developed by Brown Boveri has been used extensively for fuel inspections both in the United States and overseas. A total of 49 separate inspection campaigns had been completed through June 1987, with others planned during outages in fall 1987. As the result of inspecting nearly 500,000 fuel rods, a data base has been developed that can be used for several purposes including: (1) estimating reductions in occupational exposures achieved by identifying and removing defective fuel, (2) projecting the amount of defective fuel that may be discharged from nuclear plants, (3) comparison among fuel types, and (4) cost of inspection relative to residual fuel value.

46541 **Assessment of FREY's capabilities for steady-state self-initialization.** Bechler, E.W.; Montgomery, R.O.; Peddicord, K.L. (Texas A & M Univ., College Station (USA)). *Transactions of the American Nuclear Society;* **55**: 293-294(1987). (CONF-8711195—).

From American Nuclear Society winter meeting; Los Angeles, CA, USA (15 Nov 1987).

The ever increasing costs incurred within the nuclear fuel cycle by the utilities has accentuated the need for the accurate prediction of the behavior of light water reactor (LWR) fuel elements not only in normal operation, but also in unexpected off-normal transients or accidents. In the prediction of LWR fuel behavior during transients, it is important that accurate and compatible initialization is developed. In this study, the steady-state self-initialization capabilities were assessed for the FREY computer code. The Fuel Rod Evaluation sYstem (FREY) initiated by the Electric Power Research Institute in 1978, was developed as a general purpose fuel rod evaluation code for both transient and steady state analyses of LWR fuel rods. The FREY code utilizes a nonlinear two-dimensional finite element method designed to perform coupled thermal-hydraulic/thermomechanical analyses throughout a wide variety of conditions. Best estimate, as well as licensing analyses, can be performed. The FREY code, although designed for transient analyses, can be used to predict steady-state fuel rod behavior. This capability is useful for determining suitable fuel rod characteristics prior to a transient situation.

46542 **Radiation buildup and control in BWR recirculation piping.** Meyer, W.; Wood, R.M.; Rao, T.V.; Vook, R.W. (Syracuse Univ., NY (USA)). *Transactions of the American Nuclear Society;* **55**: 301-303(1987). (CONF-8711195—).

From American Nuclear Society winter meeting; Los Angeles, CA, USA (15 Nov 1987).

Boiling water nuclear reactors (BWRs) employ stainless steel (Types 304 or 316 NG) pipes in which high-purity water at temperatures of ~ 275°C are circulated. Various components of the system, such as valves and bearings, often contain hard facing metal alloys such as Stellite-6. These components, along with the stainless steel tubing and feedwater, serve as sources of ^{59}Co. This cobalt, along with other soluble and insoluble impurities, is carried along with the circulating water to the reactor core where it is converted to radioactive ^{60}Co. After reentering the circulating water, the ^{60}Co can be incorporated into a complex corrosion layer in the form of $CoCr_2O_4$ and/or $CoFe_2O_4$. The presence of even small amounts of ^{60}Co on the walls of BWR cooling systems is the dominant contributor to inplant radiation levels. Thus BWR owners and their agents are expending significant time and resources in efforts to reduce both the rate and amount of ^{60}Co buildup. The object of this research is twofold: (a) to form a thin diffusion barrier against the outward migration of cobalt from a cobalt-containing surface and (b) to prevent the growth of a ^{60}Co-containing corrosion film. The latter goal was the more important since most of the radioactive cobalt will originate from sources other than the stainless steel piping itself.

46543 **Effects of crud deposition of zircaloy corrosion.** Pan, C.; Jones, B.G.; Machiels, A.J. (National Tsing-Hua Univ. (Taiwan)). *Transactions of the American Nuclear Society;* **55**: 303-305(1987). (CONF-8711195—).

From American Nuclear Society winter meeting; Los Angeles, CA, USA (15 Nov 1987).

Boiling heat transfer occurs throughout most of the core of boiling water reactors, and at specific core locations in pressurized water reactors (PWRs). For higher burnups, waterside corrosion of cladding may become a life-limiting feature of fuel rod design, especially when combined with daily load-following operation. Corrosion of Zircaloy has been extensively investigated. The major high-

lights gained from this study include the following: (1) in the absence of boiling, the presence of crud deposits increases the temperature at the Zircaloy/oxide interface and, therefore, accelerates Zircaloy corrosion dramatically, especially for thick crud layers. (2) Without considering the concentration effect, wick boiling nullifies the thermal resistance due to the crud deposit and, therefore, mitigates significantly the acceleration of Zircaloy corrosion due to crud deposit. (3) With the presence of LiOH, the concentration effect in the crud deposit due to wick boiling can be very detrimental to the Zircaloy corrosion resistance performance. (4) The model prediction agrees in trend with limited plant data.

46544 Statistical test for consistency of zircaloy corrosion resistance properties. Lee, J.K.; Newsom, R.G. (Tennessee Valley Authority, Chattanooga (USA)). *Transactions of the American Nuclear Society;* **55**: 305-306(1987). (CONF-8711195—).

From American Nuclear Society winter meeting; Los Angeles, CA, USA (15 Nov 1987).

Heat treatment processes for Zircaloy tube shell and tubing have been developed by tube-shell vendors and tube manufacturers to yield material resistant to nodular corrosion. Corrosion tests are conducted by tube-shell suppliers and manufacturers to determine the corrosion resistance of Zircaloy. It is desirable as part of a total quality assurance program for a utility to evaluate the consistency of corrosion-resistance properties of the Zircaloy tube shells supplied by different vendors. For this purpose, the authors propose a statistical quality control method that uses nodular corrosion test data and designs an experiment to analyze the effect of a single factor representing nodular corrosion resistance. In this analysis, the authors apply a single-factor analysis of variance to obtain independent random samples at each of the several levels of the factor being tested and make a statistical decision concerning the effect that the levels of the test factor have on the response variable. The weight-gain data of nodular corrosion tests from different tube-shell suppliers are used as replicates in the analysis. The test method presented here is simple and can be applied by a utility as part of its quality assurance program to check the consistency of the nodular corrosion resistance of tube shells supplied by different vendors.

46545 Japanese experience in vectorizing thermohydraulic reactor codes. Ishiguro, M. *Transactions of the American Nuclear Society;* **55**: 328-329(1987). (CONF-8711195—).

From American Nuclear Society winter meeting; Los Angeles, CA, USA (15 Nov 1987).

The performance gain achieved by the vectorized 40 nuclear codes on FACOM VP-100 at Japan Atomic Energy Research Institute (JAERI) is reviewed in this paper. The average ratio of performance P of the vectorized codes in the vector mode to that achieved in the scalar mode is 5.0, with some modification. Twelve codes achieved a performance ratio exceeding 6,11 codes ranged from 3 to 6, and 17 codes fell into a low-performance gain with a ratio < 3.

46546 LWR core burnup analysis with the microcomputer. Downar, T.J. (Purdue Univ., Lafayette, IN (USA)). *Transactions of the American Nuclear Society;* **52**: 97-99(1986). (CONF-860610—Summs.).

From American Nuclear Society annual meeting; Reno, NV, USA (15 Jun 1986).

As microcomputers become faster with greater accessible memory, they become increasingly attractive for performing sophisticated core burnup calculations. They have the potential of filling the needs of both the Nuclear Engineering Department (NED) for a detailed and accurate preliminary design tool as well as the Fuel Cycle Operations Department (FCOD) for a versatile and credible multi-cycle core analysis tool. The problem in realizing this potential, however, is more the lack of adequate software than the capability of the microcomputer. A recent study performed for the Electric Power Research Institute (EPRI) provided several new insights on the difficulty of providing an analysis tool for both the multi-cycle and the single-cycle core analysis problems. This summary highlights the essential features of microcomputer software for fuel cycle analysis and suggests strategies for its implementation.

46547 LWR reactivity/isotopics code for pedagogical and scoping applications. AbuZaied, G.; Driscoll, M.J. (Massachusetts Institute of Technology, Cambridge (USA)). *Transactions of the American Nuclear Society;* **52**: 99-101(1986). (CONF-860610—Summs.).

From American Nuclear Society annual meeting; Reno, NV, USA (15 Jun 1986).

A program designated BRICC (Burnup Reactivity and Isotopic Composition Computation), has been programmed for use on microcomputers to permit rapid parametric studies of the neutronics of light water reactor (LWR) assemblies. It is currently employed as a teaching tool in a graduate-level subject on nuclear fuel management, and has proven to be of sufficient accuracy to permit its use as a submodule in a more comprehensive program used to evaluate various mechanical spectral shift concepts for pressurized water reactor control. It should also prove useful in teaching reactor physics as it will fill an important gap between hand calculations of inadequate accuracy and state-of-the-art multigroup programs of daunting complexity. The BRICC program combines a minimum adequate set of old-fashioned phenomenological submodels that describe key physics attributed in an integral fashion, thereby providing the student or researcher with convenient mental pictures to serve as the basis for deductive reasoning. The program is short, written in a simplistic version of the Basic language, with many interspersed Remark statements, and is therefore easy to tinker with for various constructive purposes.

2102 Power Reactors, Non-breeding, Light-water Moderated, Non-boiling Water Cooled

REFER ALSO TO CITATION(S) 46330, 46374, 46333, 46534, 46535, 46536, 46537, 46538, 46539, 46540, 46541, 46543, 46545, 46546, 46547, 46608, 46609, 46650, 46661, 46662, 46670, 46770, 46842, 46888, 47667

46548 (CEGB-TPRD/B—1010/R87) Review of cobalt adsorption on transition metal oxides. Walker, S.M. (Central Electricity Generating Board, Berkeley (UK). Berkeley Nuclear Labs.). Apr 1987. 36p. (PWR/CWG/P—87-510). NTIS (US Sales Only), PC A03/MF A01. Order Number DE88754273/JAW.

This report reviews studies of cobalt adsorption on transition metal oxides, in the context of corrosion product and radioactivity transport in PWR primary circuits. In general, uptake of cobalt increases with pH, with temperature and with decreasing ionic strength. Very little data are available under PWR primary circuit conditions, but the limited data available suggest that cobalt uptake by the zirconium oxide corrosion product layer on fuel pins may be significant compared to that deposited on fuel crud. If fuel crud levels can be reduced in future by coolant chemistry control then uptake by the zirconia will assume a greater relative role. It is planned to use an autoclave to study uptake of cobalt on oxidised Zircaloy surfaces at temperatures up to 593K under PWR primary circuit chemistry conditions.

46549 (CEGB-TPRD/L—3213/R87) QFLOOD-GT: a program for predicting PWR reflood. Thomas, R.M. (Central Electricity Research Labs., Leatherhead (UK)). Nov 1987. 55p. NTIS (US Sales Only), PC A04/MF A01. Order Number DE88754283/JAW.

A description is given of the present version of the QFLOOD-GT program for predicting the reflood stage of a large-break PWR loss-of-coolant accident. QFLOOD-GT has been developed from an earlier forced-reflood program which, using a conduction-controlled model for rewetting speed, gave good agreement with the FLECHT SEASET experiments. This earlier program has been incorporated into QFLOOD-GT as a subroutine called QFLOOD; in addition a downcomer model has been included in order to allow calculation of gravity reflood, and a computational scheme has been devised to simulate the chimney effect (the unequal distribution of inlet flow between hot and cool regions of the core). No quantitative comparisons between QFLOOD-GT predictions and integral-test data have yet been carried out, so the modelling decisions implemented in the program are at this stage unvalidated. Preliminary testing of the program has produced results which are for the most part qualitatively satisfactory. Calcula-

tions for indicative PWR conditions suggest that the chimney effect has a significant beneficial effect during PWR reflood, a conclusion in accordance with the findings of the Japanese 2D/3D experiments.

46550 **(CEGB-TPRD/M—1633/R87) Pre-test prediction report LOBI-MOD2 Test BT-12 large steam line break.** Lightfoot, P.; Birchley, J.; Rogers, J. (Central Electricity Generating Board, Southampton (UK). Marchwood Engineering Labs.). May 1987. 61p. (PWR-PKWG-P—87-273). NTIS (US Sales Only), PC A04/MF A01. Order Number DE88754284/JAW.

The RETRAN-02 code has been selected by the CEGB for independent assessment of the thermal hydraulic component of the intact circuit fault safety case for Sizewell B. An important source of validation data for RETRAN is the European Community sponsored LOB1-MOD2 Integral Test Facility. One component of the agreed LOB1 test matrix is the large (100%) steam line break test BT-12 for which the UK has been designated as partner country. This report details the pre-test predictions undertaken in support of Test BT-12 using the RETRAN-02/Mod 3 code. Three separate analyses are presented. In addition to the best estimate prediction, two scoping predictions are presented which respectively minimise and maximise the primary cooldown. The best estimate calculation was undertaken using dynamic slip with multi-node steam generator representations. The maximum cooldown was obtained using a single bubble rise volume broken loop steam generator model to minimise the liquid carryover to the break. The minimum cooldown used full noding for the broken loop steam generator but without slip (ie equal phase velocities) to maximise the carryover. A number of modelling difficulties had to be overcome including steady state initialisation at the zero feed and steam flow hot standby condition.

46551 **(INIS-BR—1150) Activities of Nuclebras in the area of reactor Safety. Part 1. Safety of Angra 2 and 3.** Lepecki, W.P.S. (NUCLEN, Rio de Janeiro (Brazil)). 1986. 40p. (In Portuguese). (CONF-8608221—). NTIS (US Sales Only), PC A03/MF A01. Order Number DE88703553/JAW.

From Workshop on PWR reactor safety; Rio de Janeiro, Brazil (11 Aug 1986).

The safety concept used in Brazil for licensing Angra 2 and 3 are presented. The brazilian and german responsabilities in those projects are shown. (E.G.).

46552 **(INIS-mf—11728) Ringhals 2: Pilot decontamination of heat exchanger CSAHRG-1. Summary report.** Menon, S.; Bjerler, J.; Soederman, R. (Studsvik Energiteknik AB, Nykoeping (Sweden); Swedish State Power Board, Vaellingby; ASEA-ATOM AB, Vaesteraas (Sweden)). 17 Oct 1986. 24p. NTIS (US Sales Only), PC A03/MF A01. Order Number DE88754363/JAW.

A study was carried out during 1984-85 of the feasibility of using a chemical decontamination method (patent applied for) developed by Studsvik Energiteknik AB for the decontamination of steam generators in pressurized water reactors. The object chosen for decontamination was the regenerative heat exchanger in the reactor coolant system CS-334, object designation CSAHRG-01. The decontamination process is based in the main on the use of ozone (O/sub 3/) in nitric acid solution in one step followed by rinsing with weak ascorbic acid solution. The process is carried out at room temperature.

46553 **(NUREG/CR—5061) Three-frequency eddy-current instrument.** Dodd, C.V.; Chitwood, L.D. (Oak Ridge National Lab., TN (USA)). May 1988. Contract AC05-84OR21400. 154p. (ORNL/TM—10663). NTIS, PC A08/MF A01 - GPO. Order Number TI88012500/JAW.

A three-frequency eddy-current instrument has been constructed for general multiple property applications, with particular emphasis on light water reactor steam generator tubing examination. A description is given of the overall operating principles of the complete instrument and of the operation of the different modules in the instrument. Also included are wiring and printed circuit diagrams and the necessary computer programs to run the instrument. 11 refs., 37 figs.

46554 **(UJV—7972-T) Numerical solution of the elastic non-axial contact between pellet and cladding of fuel rod in PWR.** Zymak, J. (Ustav Jaderneho Vyzkumu CSKAE, Rez (Czechoslovakia)). Aug 1987. 24p. NTIS (US Sales Only), PC A03/MF A01. Order Number DE88703945/JAW.

Elastic non-axial contacts between the pellet and the cladding of a fuel rod in a pressurized water reactor were calculated. The existence and the uniqueness of the solution were proved. The problem was approximated by the finite element method and quadratic programming was used for the solution. The results will be used in the solution of the probabilistic model of a fuel rod with non-axial pellets in a PWR. (author). 10 figs., 4 tabs., 10 refs.

46555 **Improved fuel design economics - a new evaluation tool.** Aboudara, J.L. *Transactions of the American Nuclear Society;* **55**: 107-108(1987). (CONF-8711195—).

From American Nuclear Society winter meeting; Los Angeles, CA, USA (15 Nov 1987).

Advanced fuel design technology is now beginning to be implemented with new reload regions for large pressurized water reactors. Until recently there has not been an integrated computer modeling product that would allow easy assessment of the economics of various advanced fuel design alternatives now available to utilities. The Fuel Cycle Scoping System (FCSS) was designed to fill this need. The FCSS is a personnel computer (PC) software package that is used to evaluate alternative strategies for supplying and using nuclear fuel in nuclear power reactors. The FCSS is an extremely flexible package that permits evaluation of in-core and out-of-core fuel management strategy options. For each strategy option, unit and reactor operating assumptions and assumptions for uranium supply, conversion, enrichment, fabrication, and spent fuel disposal can be made.

46556 **Operational experience with ZrB_2 integral fuel burnable absorbers.** Pritchett, J.E.; Mueller, D.E. *Transactions of the American Nuclear Society;* **55**: 117-118(1987). (CONF-8711195—).

From American Nuclear Society winter meeting; Los Angeles, CA, USA (15 Nov 1987).

This paper describes the first full-scale usage in two pressurized water reactor (PWR) cores of an integral fuel burnable absorber (IFBA) developed by Westinghouse. The IFBA design has been utilized in previous cores on a demonstration basis. The absorber used is a thin coating (< 1 mil) of zirconium diboride (ZrB_2) on the outer surface of the enriched uranium dioxide (UO_2) fuel pellet. Selected rods within certain feed assemblies contain the IFBA coating. The first IFBA-containing core began operation in March 1987 in a two-loop plant reload annual cycle. The second IFBA-containing core will begin operation later in 1987 in a three-loop reload 18-month cycle. Design predictions show that both cores could utilize IFBA to meet difficult constraints and to achieve fuel management benefits that are not possible with discrete burnable absorbers. The ultimate test for the IFBA will be the ability to perform as predicted during actual plant operation. The two-loop core measurement data obtained to date have shown good agreement with design prediction. These reaults are discussed. The design and operational experience from these two cores offer confirmation of excellent ZrB_2 predictability and performance in controlling power peaking and achieving added benefits in fuel management strategies.

46557 **Interactive computing for reload design at Westinghouse CNFD.** Cooney, B.F.; Altman, D.E.; Tyberg, M.E.; Crowley, M.D.; Paterline, D.L. *Transactions of the American Nuclear Society;* **55**: 119-120(1987). (CONF-8711195—).

From American Nuclear Society winter meeting; Los Angeles, CA, USA (15 Nov 1987).

The core design environment at Westinghouse Commercial Nuclear Fuel Division in the 1980s has developed into a challenging one, requiring up to 50 reload designs each year, utilizing increasingly more complex fuel products, more engineering services, and increasingly sophisticated utility customers. In this environment, the driving imperative is Do it right the first time. The Westinghouse Interactive System for Advanced Reload Design (WISARD) is a tool developed to utilize the capabilities of interac-

tive computing to provide the nuclear designers with the information needed in a flexible, usable format.

46558 Comparison of gadolinium and ZrB_2 as integral fuel burnable absorbers in PWRs. Srinilta, S.; Schmidt, R.F.; Pritchett, J.E. *Transactions of the American Nuclear Society;* 55: 124-126(1987). (CONF-8711195—).

From American Nuclear Society winter meeting; Los Angeles, CA, USA (15 Nov 1987).

This study compares the use of gadolinium and zirconium diboride (ZrB_2) as integral fuel burnable absorbers (IFBAs) for controlling peaking factors and maintaining an acceptable moderator temperature coefficient (MTC) in pressurized water reactors (PWRs). The ceramic Gd_2O_3 is mixed directly with UO_2, while ZrB_2 is coated on the surface of the UO_2 pellet. Because of the lower thermal conductivity and lower melting temperature in the mixture of Gd_2O_3 + UO_2 a reduced uranium enrichment in the gadolinium bearing rods is required. In the ZrB_2 application, the depletion produces additional helium gas; therefore, the initial backfilled gas pressure has to be reduced. The use of either absorber results in a more complete burnout relative to lumped burnable absorbers, thereby yielding improved uranium utilization. ZrB_2 is favored over gadolinium as the integral fuel burnable absorber for PWRs because of improved power peaking control, reduced residual activity, and its unchanged uranium enrichment requirement. These factors lead to longer cycle lengths and greater fuel management flexibility in PWRs. The use of ZrB_2 IFBAs provides a more economical and flexible burnable absorber than gadolinium for PWR applications.

46559 Gradual commercialization of advanced PWR tight lattice cores. Moldaschl, H.; Zeggel, W. *Transactions of the American Nuclear Society;* 55: 126-127(1987). (CONF-8711195—).

From American Nuclear Society winter meeting; Los Angeles, CA, USA (15 Nov 1987).

The high commercial success of current pressurized water reactor (PWR) nuclear power stations is an incentive to carry this technology to advanced design. Among the goals for future plants, great importance is placed on significantly improving fuel utilization and energy efficiency: since commercialization of the fast breeder reactor may be delayed into the next century, improved fuel utilization in light water reactors (LWRs) increases in importance. First steps have been successfully achieved by burning plutonium in LWRs. Further development led to advanced LWR core design with specific features like better reflectors, spectral shift displacement rods, or low-leakage management strategies. Even if applied in combination, however, they will not bring an ore savings effect of more than 20%.

46560 Modifications of water chemistry for pressurized water reactors. Fletcher, W.D. *Transactions of the American Nuclear Society;* 55: 252-254(1987). (CONF-8711195—).

From American Nuclear Society winter meeting; Los Angeles, CA, USA (15 Nov 1987).

For commercial pressurized water reactors, the evolution of the water chemistry for both the reactor coolant systems (RCS) and the balance of plant (BOP) systems has been in concert with or responsive to the changes in specified materials and operating experience. Much of the early reactor coolant chemistry was identified within a program to develop the use of boric acid as a water soluble neutron absorber for chemical shim. Boric acid was selected as the absorber. The BOP steam and feedwater cycle chemistry was largely a translation from conventional low-pressure boiler water chemistry with specific changes to account for new materials in major components. Today's chemistry for the reactor and BOP systems has undergone significant changes since circa 1950. With advances in the design duty of the plant components and with a much better understanding of the mechanisms of corrosion of component materials, the water chemistry practices and methods of control are more successfully aimed at plant reliability than ever before. This paper presents a review of several important advances in water chemistry, as applied to both the RCS and the BOP and the basis for their adoption.

46561 Materials choices for the advanced LWR steam generators. Paine, J.P.N.; Shoemaker, C.E.; McIlree, A.R. *Transactions of the American Nuclear Society;* 55: 257-259(1987). (CONF-8711195—).

From American Nuclear Society winter meeting; Los Angeles, CA, USA (15 Nov 1987).

Current light water reactor (LWR) steam generators have been affected by a variety of corrosion and mechanical damage degradation mechanisms. Included are wear caused by tube vibration, intergranular corrosion, pitting, and thinning or wastage of the steam generator tubing and accelerated corrosion of carbon steel supports (denting). The Electric Power Research Institute (EPRI) and the Steam Generator Owners Groups (I, II) have sponsored laboratory and field studies to provide ameliorative actions for the majority of the damage forms experienced to date. Some of the current corrosion mechanisms are aggravated or caused by unique materials choices or materials interactions. New materials have been proposed and at least partially qualified for use in replacement model steam generators, including an advanced LWR design. In so far as possible, the materials choices for the advanced LWR steam generator avoid the corrosion pitfalls seemingly inherent in the current designs. The EPRI Steam Generator Project staff has recommended materials and design choices for a new steam generator. Based on these recommendations we believe that the advanced LWR steam generators will be much less affected by corrosion and mechanical damage mechanisms than are now experienced.

46562 New options for improved steam generator U-bend integrity. Gutzwiller, J.E.; Glass, S.W. *Transactions of the American Nuclear Society;* 55: 259-260(1987). (CONF-8711195—).

From American Nuclear Society winter meeting; Los Angeles, CA, USA (15 Nov 1987).

Primary-side intergranular stress corrosion cracking (IGSCC) has been noted in the U-bend region of first- and second-row Alloy 600 tubes in pressurized water reactor recirculating steam generators. The cracks have been found primarily at the apex and near the tangents of the bends on the extrados (outside bend radius) and in the sides near the small radius of the curvature portion of the distorted tube. During fabrication, the tubes were bent without stress relief. High residual strains are therefore present in these tube sections. Further, laboratory tests have shown Inconel 600 material to be susceptible to IGSCC at nuclear steam supply system operating temperatures. Although the cracking mechanism is generally understood, the tight radius bend, the tube ovality, and the complications of working in a radioactive steam generator make inspection and repair of these regions challenging. Babcock & Wilcox has initiated three programs to attack the U-bend cracking problems: applying rotating probe technology for better tube examinations, stress relieving the tubes to retard IGSCC, and removing plugs to return previously plugged tubes to service. Collectively, these three programs provide a valuable tool to keep the small radius U-bend tubes of commercial nuclear systems in service.

46563 Comparative study of actual nuclear plant transients for several plants and implications for fatigue usage. Massie, H.W. Jr. *Transactions of the American Nuclear Society;* 55: 268-269(1987). (CONF-8711195—).

From American Nuclear Society winter meeting; Los Angeles, CA, USA (15 Nov 1987).

Westinghouse has completed four nuclear plant life extension studies (PLEX), which involved the counting of plant transients and fatigue assessment of critical nuclear steam supply system components. For the first time, a comparison is made among four different plants. The plants ranged in net power rating from 320 to 781 MW(electric), covered two-, three-, and four-loop Westinghouse configurations, and experienced 13 to 18 yr of actual operation. For Westinghouse-designed plants, a systems standard design criteria document is issued to the component designer that specifies the number of design transients, severity, and type. In general, fatigue should not be the most limiting degradation mechanism during the plant operating design lifetime. For life extension, selected areas in the plant will have to be reevaluated. In any event, fatigue is an irreversible degradation mechanism and should be closely monitored by a plant owner. The transient count of actual transients, as compared to the original design transients, illustrates that margins

exist in some cases in the number of transient occurrences and in the severity of the transients. Optimism exists for margin available that will be useful for PLEX and/or considerations of environmental effects on the S-N curve of the American Society of Mechanical Engineers code.

46564 **Assessment and implementation of reactor vessel life extension.** Moylan, M.F.; Balkey, K.R. *Transactions of the American Nuclear Society;* 55: 269-270(1987). (CONF-8711195—).

From American Nuclear Society winter meeting; Los Angeles, CA, USA (15 Nov 1987).

Recent studies have indicated that the reactor pressure vessel may be the limiting component with respect to plant life extension for many nuclear power plants. This paper discusses the approach utilized to assess the structural life of the Point Beach Units 1 and 2 reactor vessels and current results from the evaluation of the most cost-effective means for maintaining the option to extend that life by 20 yr beyond the normal license term. The key to extending Point Beach reactor vessel life centers on reducing neutron embrittlement such that the beltline weld properties remain within critical material and regulatory limits. A secondary consideration for reactor vessel life extension involves establishing a transient monitoring program to account for fatigue and fatigue crack growth. The transient monitoring program for fatigue includes other critical nuclear stream supply system components as well as the critical reactor vessel locations.

46565 **Fission gas release and transport model for high-burnup PWR models.** Kinoshita, M.; Matsui, T.; Fukuya, K. *Transactions of the American Nuclear Society;* 55: 295-296(1987). (CONF-8711195—).

From American Nuclear Society winter meeting; Los Angeles, CA, USA (15 Nov 1987).

To minimize fuel cycle cost, Japanese utilities are planning to convert to extended burnup operation in the near future. However, there is concern that enhanced fission gas release will result in increased rod internal pressure. Some remedies for fuel pellets, such as large grain or doped pellets, are proposed and under examination to reduce fission gas release. To evaluate the effects of these improvements, we developed a diffusion based gas release and transport model that is applicable to the quantitative investigation of detailed phenomena at high burnup. These models are implemented in the IRON code and verified against its pressurized water reactor (PWR) fuel data base. This code is now applicable to the analyses for the extended burnup operation up to 55 MWd/kgU.

46566 **Application of symbolic manipulation to stochastic estimation.** Jackson, P.S. *Transactions of the American Nuclear Society;* 55: 314-315(1987). (CONF-8711195—).

From American Nuclear Society winter meeting; Los Angeles, CA, USA (15 Nov 1987).

The advent of software for the development of mathematical models using symbolic manipulation has greatly expanded the scope of engineering problems for which closed solutions or explicit analytical approximations can be determined. Experience with one symbolic manipulator indicates powerful capabilities for practical engineering problems. An example of the use of symbolic manipulation for a problem in stochastic estimation is presented in this paper. Advantages of the symbolic solution are discussed and compared with the traditional numerical approaches to this problem.

46567 **Out-of-core nuclear fuel cycle optimization utilizing an engineering workstation.** Turinsky, P.J.; Comes, S.A. (North Carolina State Univ., Raleigh (USA)). *Transactions of the American Nuclear Society;* 52: 94-96(1986). (CONF-860610—Summs.).

From American Nuclear Society annual meeting; Reno, NV, USA (15 Jun 1986).

Within the past several years, rapid advances in computer technology have resulted in substantial increases in their performance. The net effect is that problems that could previously only be executed on mainframe computers can now be executed on micro- and minicomputers. The authors are interested in developing an engineering workstation for nuclear fuel management applications. An engineering workstation is defined as a microcomputer with enhanced graphics and communication capabilities. Current fuel management applications range from using workstations as front-end/back-end processors for mainframe computers to completing fuel management scoping calculations. More recently, interest in using workstations for final in-core design calculations has appeared. The authors have used the VAX 11/750 minicomputer, which is not truly an engineering workstation but has comparable performance, to complete both in-core and out-of-core fuel management scoping studies. In this paper, the authors concentrate on our out-of-core research. While much previous work in this area has dealt with decisions concerned with equilibrium cycles, the current project addresses the more realistic situation of nonequilibrium cycles.

2103 Power Reactors, Non-breeding, Graphite Moderated

REFER ALSO TO CITATION(S) 46332, 46642, 46646, 46648, 46655, 46768, 46961, 47392, 47395

46568 **(CEGB-TPRD/B—0963/R87) Spectroscopic characterisation of iodine deposits on 18%Cr/8%Ni and mild steel surfaces oxidised in CO/sub 2//CH/sub 3/I gas mixtures.** Tyler, J.W. (Central Electricity Generating Board, Berkeley (UK). Berkeley Nuclear Labs.). Aug 1987. 57p. (ARPWG/P—87-38). NTIS (US Sales Only), PC A04/MF A01. Order Number DE88754269/JAW.

An understanding and quantification of iodine-131 attenuation within the gas circuit of a Commercial Advanced Gas-cooled Reactor is required for reactor safety assessments. To this end it is desirable to identify the chemical state of iodine in the gas phase or when deposited on reactor surfaces. Samples of 18%Cr/8%Ni and mild steel pipe, with iodine deposited on their surfaces following oxidation in CO/sub 2//CH/sub 3/I gas mixtures, have been characterised in the present work using a variety of different spectroscopic techniques including X-ray photoelectron spectroscopy, scanning electron microscopy, energy dispersive X-ray analysis, scanning Auger microscopy and X-ray diffraction. The chemical nature of the deposited iodine has been determined by X-ray photoelectron spectroscopy to be a metal iodide by correlating I 3d binding energies with those obtained from well characterised standards; the binding energies of the ejected I 3d photoelectrons being sensitive to the chemical environment experienced by the iodine atoms. The distribution of iodine throughout the oxide layers formed on these steels was determined by repeated cycles of argon-ion bombardment and analysis to build up an elemental depth profile whilst at the same time determining the chemical state of the elements present. Differences in oxide composition and morphology are discussed in relation to the deposition behaviour observed on 18%Cr/8%Ni and mild steel and it is suggested that gradual incorporation of the iodine occurs throughout the oxidation/deposition period. (U.K.).

46569 **(CEGB-TPRD/B—1000/R87) Investigations into the effect of spinel oxide composition on rate of carbon deposition.** Allen, G.C.; Jutson, J.A. (Central Electricity Generating Board, Berkeley (UK). Berkeley Nuclear Labs.). Nov 1987. 21p. NTIS (US Sales Only), PC A03/MF A01. Order Number DE88754296/JAW.

The deposition of carbon on fuel cladding and other steels results in a reduction in heat transfer efficiency. Methane and carbon monoxide are added to the gaseous coolant in the Advanced Gas Cooled Reactor (AGR) to reduce the radiolytic oxidation of the graphite moderator and this is known to increase the rate of carbon deposition. However, the composition of oxides formed on steel surfaces within the reactor may also influence deposition. In this investigation carefully characterised spinel type oxides of varying composition have been subjected to {gamma} radiation under conditions of temperature, preasure and atmosphere similar to those experienced in the reactor. The rate of carbon deposition has been studied using Scanning Electron Microscopy (SEM) and Energy Dispersive X-ray Analysis (EDX). (U.K.).

46570 (CEGB-TPRD/M—1683/RR88) Treatment of surface oxide for reactor repair welding. Morgan-Warren, E.J. (Central Electricity Generating Board, Southampton (UK). Marchwood Engineering Labs.). Jan 1988. 8p. NTIS (US Sales Only), PC A02/MF A01. Order Number DE88754285/JAW.

A description is presented of potential methods for the treatment of surface oxide in magnox reactors in preparation for repair welding. Advanced weld process fluxing techniques together with mechanical, thermal and chemical cleaning methods are examined in relation to their state of development and feasibility. It is considered that in the short term, mechanical cleaning methods are most likely to be applicable. Weld process fluxing is shown to be a viable technique where the oxide thickness is low, and could form the basis of a medium term development. Possible longer term developments include chemical and thermal cleaning techniques. Recommendations are made for a number of work areas with a view to developing a strategy applicable to the magnox repair programme.

46571 (CONF-880702—15) Economic characteristics of a smaller, simpler reactor. LaBar, M.; Bowers, H. (Oak Ridge National Lab., TN (USA)). 1988. Contract AC05-84OR21400. 5p. NTIS, PC A02. Order Number DE88012493/JAW.

From 23. intersociety energy conversion engineering conference; Denver, CO, USA (31 Jul 1988).

Reduced load growth and heightened concern with economic risk has led to an expressed utility preference for smaller capacity additions. The Modular High Temperature Reactor (MHTGR) plant has been developed as a small, simple plant that has limited financial risk and is economically competitive with comparatively sized coal plants. Competitive economics is achieved by the simplifications made possible in a small MHTGR, reduction in the quantity of nuclear grade construction and design standardization and certification. Assessments show the MHTGR plant to have an economic advantage over coal plants for plant sizes from 270 MWe to 1080 MWe. Financial risk is limited by small unit sizes and short lead times that allow incremental deployment. Evaluations show the MHTGR incremental deployment capability to reduce negative cash flows by almost a factor of 2 relative to that required by a single large nuclear plant.

46572 (TsNIIATOMINFORM-ON—4-86) Production and release of /sup 14/C in nuclear power station with RBMK-reactors. Gajko, V.B.; Korablev, N.A.; Solov'ev, E.N.; Trosheva, T.I.; Shamov, V.P. (Gosudarstvennyj Komitet po Ispol'zovaniyu Atomnoj Ehnergii SSSR, Moscow; Ministerstvo Zdravookhraneniya SSSR, Moscow. Natsional'naya Komissiya po Radiatsionnoj Zashchite). 1986. 12p. (In Russian). NTIS (US Sales Only), PC A03/MF A01. Order Number DE88703809/JAW.

This paper presents the results of experimental estimation of /sup 14/C production and release in the RBMK-reactor power station. /sup 14/C content measured both in its production points in the reactor (the periodic monitoring) and in the points of release to the atmosphere (current monitoring). /sup 14/C release to the atmosphere is determined by its production in the coolant (2.8 10/sup 8/ Bq/(MW year)), in the helium-nitrogen circuit for the reactor space purging /3.0 10/sup 8/ Bq/(MW year)/, in the nitrogen circuit of the around-reactor metalwork purging /5.2 10/sup 8/ Bq/(MW year)/ and in the cooling system of the control and protection systems /0.9 10/sup 8/ Bq/(MW year)/. Practically, /sup 14/C formed in the fuels and graphite does not enter to the Nuclear Power Station environment. /sup 14/C normalized release rate through the ventilation systems to the atmosphere is 12.8x10/sup 8/ Bq/(MWxyear), and is in good agreement with its production value in the reactor systems 11.9x10/sup 8/ Bq/(MWxyear)/. These results are obtained for 10 vol.% nitrogen content in the helium-nitrogen mixture intended for the reactor space purging. 9 refs.; 1 fig.; 3 tabs.

2105 Power Reactors, Breeding

REFER ALSO TO CITATION(S) 46600, 46601, 46649

46573 Breached oxide blanket fuel behavior in an LMR. Bottcher, J.H.; Lambert, J.D.B.; Nomura, S.; Suzuki, F. (Argonne National Lab., IL (USA)). *Transactions of the American Nuclear Society;* 55: 290-292(1987). (CONF-8711195—).

From American Nuclear Society winter meeting; Los Angeles, CA, USA (15 Nov 1987).

The run-beyond-cladding-breach (RBCB) behavior of fertile uranium dioxide fuel poses the same questions as that of exposed driver fuel to liquid-metal reactor (LMR) operations and maintenance. If sodium reacts with the blanket fuel, the product may be sufficient to induce cladding loading. This loading, then, has the potential to extend and/or induce cladding failures and degrade overall rod integrity. These open breaches expose fuel or reaction product to sodium and release fission gas, and delayed neutrons, and, potentially, fuel to the primary coolant. These phenomena are being studied as part of a joint program in Experimental Breeder Reactor II (EBR-II) between the US Dept. of Energy and the Power Reactor and Nuclear Fuel Development Corporation of Japan. Operation of this breached blanket pin caused no operational problems at EBR-II, and the overall consequences of RBCB operation of blanket fuel appears to be benign.

46574 Thermal conductivity of Na_3(U/sub 1-y/Pu/sub y/O_4: a preliminary in-pile determination. Lee, M.J.; Lambert, J.D.B.; Ukai, S.; Odo, T. (Argonne National Lab., IL (USA)). *Transactions of the American Nuclear Society;* 55: 294-295(1987). (CONF-8711195—).

From American Nuclear Society winter meeting; Los Angeles, CA, USA (15 Nov 1987).

During run-beyond-cladding-breach (RBCB) operation in an oxide liquid metal breeder, the performance of a breached fuel element is intimately associated with the formation of fuel/sodium reaction product (FSRP), Na_3(U/sub 1-y/Pu/sub y/)O_4. In-pile experiments coupled with destructive examinations of breached fuel have consistently revealed noticeable changes in fuel structure accompanying FSRP formation at the fuel surface. Previous analyses have also indicated a significant impact of FSRP on fuel centerline temperature. Successful modeling of breached fuel thermal behavior therefore requires a reasonably accurate knowledge of the thermal properties of the FSRP, especially its thermal conductivity. But laboratory investigations have been scarce and limited to the Na/UO_3 system because of the toxicity of plutonium and hygroscopicity of the FSRP. Hence, postirradiation observations of fuel samples remain the most amenable way of deriving the thermal conductivity of the FSRP. Such work is a spin-off of the RBCB program in the Experimental Breeder Reactor-II (EBR-II), a program jointly sponsored by the US Dept. of Energy and the Power Reactor and Nuclear Fuel Development Corporation of Japan.

2106 Power Reactors, Auxiliary, Mobile, Package, And Transportable

REFER ALSO TO CITATION(S) 46663, 46664

46575 (GAO/RCED—88-23) Nuclear science: Challenges facing space reactor power systems development. (General Accounting Office, Washington, DC (USA). Resources, Community and Economic Development Div.). 1987. 41p. General Accounting Office, PO Box 6015, Gaithersburg, MD 20877.

The Department of Energy is participating in two programs with other federal organizations to research and develop technology for space nuclear reactor power systems capable of delivering electrical power in the multihundred kilowatt and multimegawatt range. Although the multihundred kilowatt - SP-100 - program is much further along than the multimegawatt program, both are in early stages of development. The programs are under joint sponsorship of several federal organizations but DOE is primarily responsi-

ble for developing space-based nuclear reactor power systems technology for both programs.

46576 Simulation of the preliminary General Electric SP-100 space reactor concept using the ATHENA computer code. Fletcher, C.D. (EG & G Idaho Inc., Idaho Falls (USA)). pp 101-109 of Space nuclear power systems, 1986: Volume 5. El-Genk, M.S.; Hoover, M.D. (eds.). Malabar, FL; ORBIT Book Company, Inc. (1987). (CONF-860102—).

From 3. symposium on space nuclear power systems; Albuquerque, NM, USA (13 Jan 1986).

The capability of perform thermal-hydraulic analyses of a space reactor using the Advanced Thermal-Hydraulic Energy Network Analyzer (ATHENA) computer code is demonstrated. The fast reactor, liquid-lithium coolant loops, and lithium-filled heat pipes of the preliminary General Electric SP-100 design were modeled with ATHENA. Two demonstration transient calculations were performed simulating accident conditions. Calculated results are available for display using the Nuclear Plant Analyzer color graphics analysis tool in addition to traditional plots. ATHENA-calculated results appear reasonable for both steady state full power conditions, and the two transients. This analysis represents the first known transient thermal-hydraulic simulation using an integral space reactor system model incorporating heat pipes.

46577 Nitride fuels irradiation performance data base. Brozak, D.E.; Thomas, J.K.; Peddicord, K.L. (Texas A & M Univ., College Station (USA)). *Transactions of the American Nuclear Society;* **55**: 296-298(1987). (CONF-8711195—).

From American Nuclear Society winter meeting; Los Angeles, CA, USA (15 Nov 1987).

An irradiation performance data base for nitride fuels has been developed from an extensive literature search and review that emphasized uranium nitride, but also included performance data for mixed nitrides [(U,Pu)N] and carbonitrides [(U,Pu)C,N] to increase the quantity and depth of pin data available. This work represents a very extensive effort to systematically collect and organize irradiation data for nitride-based fuels. The data base has many potential applications. First, it can facilitate parametric studies of nitride-based fuels to be performed using a wide range of pin designs and operating conditions. This should aid in the identification of important parameters and design requirements for multimegawatt and SP-100 fuel systems. Secondly, the data base can be used to evaluate fuel performance models. For detailed studies, it can serve as a guide to selecting a small group of pin specimens for extensive characterization. Finally, the data base will serve as an easily accessible and expandable source of irradiation performance information for nitride fuels.

46578 Creep measurements for low-melting-point metals. Portal, M.E.G.; Peddicord, K.L. (Texas A & M Univ., College Station (USA)). *Transactions of the American Nuclear Society;* **55**: 300-301(1987). (CONF-8711195—).

From American Nuclear Society winter meeting; Los Angeles, CA, USA (15 Nov 1987).

Because of its suitable thermophysical properties, lithium has been selected as the coolant in the SP-100 space reactor design. During launch, the lithium will be maintained in a solid state in the reactor core and in the primary piping. To reach operational status, the lithium must be thawed. The thawing of the metal will take place in the constricted volume of the reactor vessel, and thus stresses will be transmitted to walls of the system due to thermal expansion and the volume change associated with melting. To develop a complete model of the thawing process, accurate data will be needed for properties such as the creep of lithium in the range of temperatures required for the thaw process. Unfortunately, little data concerning these mechanical properties exist. This lack of data is primarily due to the difficulties associated with conducting an experiment with such a chemically reactive metal. A macroscopic investigation of the thawing behavior of lithium was conducted in a mock-up of a reactor core type SP-100. No adverse effects on the reactor core were identified, but no actual creep measurements were made. In order to verify the feasibility of creep studies on alkali metals, a creep measuring device has been designed, constructed, and tested for low-melting-point metals. The testing device developed was composed of three major parts: a heating element to achieve the desired temperature, a compressive device to apply loads to the sample, and a camera to record the deformations in the test element nonintrusively.

46579 Vectorized performance of a transient heat-conduction model. Nassersharif, B.; DeHart, M.D. (Texas A & M Univ., College Station (USA)). *Transactions of the American Nuclear Society;* **55**: 334-335(1987). (CONF-8711195—).

From American Nuclear Society winter meeting; Los Angeles, CA, USA (15 Nov 1987).

Current interest in the application of nuclear-reactor-driven power systems to space missions has generated a need for an accurate systems model that is capable of handling the special problems and requirements of such a system. A project to develop a code specifically designed to model and analyze space reactor systems has been initiated at Texas A & M University, and the first version is nearing completion, with release of the first version anticipated in the summer of 1987. This code, named CENTAR (Code for Extended Nonlinear Transient Analysis of Extraterrestrial Reactor Systems), is superior to many systems models currently used because it is written especially for space systems and is highly vectorizable. CENTAR represents a significant step forward in space power system modeling; codes used for most current modeling efforts have among their flaws a lack of vectorizability.

2108 Economics

REFER ALSO TO CITATION(S) 46533, 46571, 46598

46580 (IAEA-TECDOC—439) Energy and electricity planning study for Jordan up to the year 2010. Report prepared by the Jordan Electricity Authority with guidance of the International Atomic Energy Agency. (International Atomic Energy Agency, Vienna (Austria)). Dec 1987. 261p. NTIS (US Sales Only), PC A12/MF A01. Order Number DE88703831/JAW.

The present report describes a study conducted in co-operation with Jordan authorities and covers the energy and electricity requirements and the optimal electric power expansion programme for this country up to year 2010. A brief description of the methodology of this EEP study is given. The present and historical energy and economic situation of Jordan is outlined. A scenario description is included. An analysis is made of the results for future energy and electricity demands and generation system expansion. Figs and tabs.

46581 (NEI-SE—14) Electric power supply strategy in Sweden 1987-2010. (KRAFTSAM, Stockholm (Sweden)). 1986. 20p. (In Swedish). NTIS (US Sales Only), PC A03/MF A01. Order Number DE88753655/JAW.

The overall strategy to replace nuclear power should comprise the following: - Large and immediate efforts to develop and demonstrate i.a. novel techniques for electric energy conservation. - Program to develop techniques for electric power production. - A gradual increase of electricity rates of about 50-100 %, depending on client category. (O.S.).

46582 Short-term uranium price formation: a methodology. Hsieh, L.Y.; de Graffenried, C.L. *Transactions of the American Nuclear Society;* **55**: 122-124(1987). (CONF-8711195—).

From American Nuclear Society winter meeting; Los Angeles, CA, USA (15 Nov 1987).

One of the major problems in analyzing the short-term uranium market is the lack of a well-defined spot market price. The two primary sources of price data covering the US uranium market are the series published by the US Dept. of Energy (DOE) and by the Nuclear Exchange Corporation (NUEXCO), a private brokerage firm. Because of the differences in both definition and coverage, these two series are not directly comparable. In this study, an econometric model was developed for analyzing the interrelationship between short-term uranium price (NUEXCO exchange value), supply, demand, and future price expectations formed by market participants. The validity of this model has been demonstrated by the fact that all simulation statistics derived are highly significant. Three forecasting scenarios were developed in this study.

46583 **Integrated approach to fuel consolidation.** Matheson, J.E.; Tucoulat, D. *Transactions of the American Nuclear Society;* **55**: 138-140(1987). (CONF-8711195—).

From American Nuclear Society winter meeting; Los Angeles, CA, USA (15 Nov 1987).

The spent fuel pools at nuclear reactors are rapidly filling up. The US Dept. of Energy (DOE) in accordance with the Nuclear Waste Policy Act plans to alleviate this problem in 1998. Meanwhile, to the storage problem solutions are actively being sought. Specifically, three new choices are available to utilities today: fuel consolidation, on-site dry storage, and a combination of both consolidation and dry storage. The discussion reviews work recently completed in the development and design of fuel consolidation equipment and makes recommendations regarding the performance requirements for such machines. To render the maximum possible additional storage space with the least negative impact on utility operations, fuel consolidation machinery must be simple, reliable, versatile, and complete. If any of these elements is missing, the problems are only shifted-not solved.

46584 **Integrated assessment of structural materials deterioration for NUPLEX evaluations.** Lapides, M.E.; Carey, J. *Transactions of the American Nuclear Society;* **55**: 267-268(1987). (CONF-8711195—).

From American Nuclear Society winter meeting; Los Angeles, CA, USA (15 Nov 1987).

Nuclear Plant Life Extension (NUPLEX) is a management decision process that focuses on defining risks and rewards associated with extending the service life of a nuclear unit. After some preliminary screening activities, management is specifically concerned with defining the trade-offs among maintenance, repairs, and replacements that are most likely to provide economically attractive service for the desired extended period. These strategic maintenance decisions are usually dictated by what is known or not known about long-term deterioration effects. Such issues are usually not evident in our design experience base or in current codes and standards. One can choose to examine them as isolated phenomena - or in some manner that fosters an integrated perspective deriving from various specialized views. While there is much to be said for each method, the unique timing and decision requirements of NUPLEX favor the latter approach. This paper illustrates why this approach is being pursued and explains its status.

46585 **Application of a personal computer relational data base management system to fuel cycle economic scoping.** Malone, J.P.; Dooley, G.D. *Transactions of the American Nuclear Society;* **52**: 96-97(1986). (CONF-860610—Summs.).

From American Nuclear Society annual meeting; Reno, NV, USA (15 Jun 1986).

A personal computer (PC) relational data base management system (RDBMS) permits large quantities of data to be maintained in a data base composed of structured data sets or files and provides data access through a software environment, procedure, or program language. The features of an RDBMS-based system create an environment on a PC that can provide significant benefits to any fuel cycle economics analysis. The ability to maintain a separate data set for each fuel cycle parameter group and the ability to manipulate the data through a series of independent calculation modules combine to provide the fuel cycle analyst with more time to examine and use the data, because less time is required to manipulate it.

46586 **Nuclear design and fuel cycle codes for the IBM PC.** Little, W.W. (Pacific Northwest Lab., Richland, WA (USA)). *Transactions of the American Nuclear Society;* **52**: 101(1986). (CONF-860610—Summs.).

From American Nuclear Society annual meeting; Reno, NV, USA (15 Jun 1986).

The one-dimensional 1DX diffusion cross-section code and the two-dimensional 2DB diffusion burnup code have been extensively revised for efficient use on personal computers (PCs). For both codes, all capabilities and options have been maintained or enhanced - including K/sub eff/ and alpha eigenvalue options and flexible search options on material concentrations and zone dimensions. Since the 1DX code uses the Evaluated Nuclear Data File Version V (ENDF/B-V) as the source file for generating effective nuclear cross sections, availability of the 1DX code to PC users significantly expands access to this well-documented and closely evaluated data file. The 1DX and 2DB codes have been used for many years on mainframe computers for cross-section generation, reactor design, and fuel burnup calculations. The conciseness of these codes and their relatively short running times make them well-suited for use with current-generation PCs. The principal modifications to the mainframe versions were to add a generalized, position-independent, input module to facilitate input by terminal, and to compress the output print to be compatible with video display.

46587 **EASE + CORE system for fuel cycle management.** Long, A.B.; Holzer, J.M. *Transactions of the American Nuclear Society;* **52**: 101-102(1986). (CONF-860610—Summs.).

From American Nuclear Society annual meeting; Reno, NV, USA (15 Jun 1986).

A PC software environment, EASE + CORE, is described that enables engineers to perform productively fuel cycle management analysis and data storage. The specific application modules, whether on a mainframe or PC, can be selected to meet the needs and desires of the particular organization.

22 NUCLEAR REACTOR TECHNOLOGY

2201 Theory And Calculation

REFER ALSO TO CITATION(S) 46586, 47123, 47668

46588 **S/sub n/ transport calculations on vector and parallel processors.** Rhoades, W.A.; Childs, R.L. (Oak Ridge National Lab., TN (USA)). *Transactions of the American Nuclear Society;* **55**: 320-321(1987). (CONF-8711195—).

From American Nuclear Society winter meeting; Los Angeles, CA, USA (15 Nov 1987).

The transport of radiation from its source to the location of people or equipment gives rise to some of the most challenging of calculations. A problem may involve as many as a billion unknowns, each evaluated several times to resolve interdependence. Such calculations run many hours on a CRAY computer, and a typical study involves many such calculations. The DOT code, which solves transport problems in two space dimensions, can be vectorized and extended to three-dimensions. Plans are being made to extend it to parallel processors. Repeated analysis, recoding, and reanalysis was required to vectorize the procedures. Each major section of the code required a different technique. In some cases, the new procedures improved performance on a scalar IBM machine, while parallel coding was required in others. It is not clear what coding techniques and computer architectures will offer the best performance in the future. Only competition and experimentation will reveal that.

46589 **Evaluation of a simplified version of KENO V.a on a parallel processors computer.** Ugolini, D.; Petrie, L.M.; Dodds, H.L. Jr. (Univ. of Tennessee, Knoxville (USA)). *Transactions of the American Nuclear Society;* **55**: 326-327(1987). (CONF-8711195—).

From American Nuclear Society winter meeting; Los Angeles, CA, USA (15 Nov 1987).

KENO V.a is a widely used Monte Carlo criticality code developed by Oak Ridge National Laboratory for use primarily on large single processor mainframe computers. The code can be very costly to use if a large number of histories is required because the histories are performed sequentially via the single processor. With the advent of parallel processor computers, it should be possible to reduce computing costs (i.e., computer run time) by performing the histories in parallel. The purposes of this work is to implement KENO V.a on a parallel processor computer, specifically the NCUBE and then to compare results obtained on the NCUBE (i.e., accuracy and computing time) with results obtained on a large mainframe computer (IBM 3033). The NCUBE is a message-passing machine with no shared memory. A simplified version of KENO V.a was developed for this study because the standard version was too large to compile on the NCUBE. In addition, a special 1-group cross-section library, reduced from the standard 16-group

Hansen Roach Library, was also used. The sample problem used in this study was an 18-cm-diam sphere of ^{238}U at 0.05 atom/b x cm.

46580 Study of algorithms to enhance vector performance of thermal-hydraulic codes based on a hopscotch scheme. Majumdar, A.; Makowitz, H. (Idaho State Univ., Pocatello (USA)). *Transactions of the American Nuclear Society;* **55**: 331-334(1987). (CONF-8711195—).

From American Nuclear Society winter meeting; Los Angeles, CA, USA (15 Nov 1987).

Many current reactor thermal-hydraulic codes spend a significant portion of their computational time on recursive direct matrix solutions and consequently are not able to utilize the performance that can be obtained with modern vector computers such as the CRAY X-MP/48 and the CDC CYBER 205. In this paper, the authors present numerical schemes based on the Hopscotch algorithm. These algorithms can be fully vectorized and do not require matrix inversions. The authors have developed a new intermediate iterative stabilizing step and have incorporated it in the basic Hopscotch scheme. Due to this development, the time step size can be increased well beyond the theoretical stability limit of the original Hopscotch algorithm. This new algorithm, EPIC, works significantly faster than a fully implicit direct solution scheme. A one-dimensional, time-dependent, heat conduction equation has been used in this study as an example.

2202 Components And Accessories

REFER ALSO TO CITATION(S) 46776, 46878

46591 (CEGB-TPRD/L—3189/R87) Erosion-corrosion of boiler inlet ferrule assemblies: Part 4. Temperature and flow dependency at pH 9.50. Garbett, K.; Bignold, G.J.; Whalley, C.H. de; Libaert, D.F.; Sale, R.; Woolsey, I.S. (Central Electricity Research Labs., Leatherhead (UK)). Oct 1987. 45p. NTIS (US Sales Only), PC A03/MF A01. Order Number DE88754282/JAW.

Results are given for four experiments carried out on the CERL Isothermal Rig aimed at defining the temperature and flow dependency of erosion-corrosion at pH 9.30 and 9.50. At pH 9.50 it was found that the flow dependency for the maximum rate in the post-orifice region was relatively low, Vsup(1.08) to Vsup(1.34), and showed only a small variation with temperature, the dependency tending to increase with increasing temperature. This behaviour differs from that seen at pH 9.04 where a higher flow dependency and a greater variation with temperature was seen. An assessment of the available data indicates that the flow dependency falls significantly as pH rises from 9.0 to 9.3, but that thereafter there is little further change up to pH 9.65. The temperature dependency at pH 9.50 gave a peak in the erosion-corrosion rate at about 135/sup 0/C, the position of which moved to higher temperatures with increasing rates. Compared with the data at pH 9.04, the temperature maxima occurred at higher temperatures at equivalent erosion-corrosion rates. A comparison of the data at pH 9.04 and 9.50 shows that there is no unique pH dependency for erosion-corrosion under the conditions tested. At 115/sup 0/C an almost constant pH dependency was found, but at higher temperatures there was a marked variation in pH dependency with flow. For 100% MCR conditions at 149/sup 0/C, the present data are consistent with those obtained in early Isothermal Rig experiments.

46592 (EPRI-NP—5911M) Acceptance criteria for structural evaluation of erosion-corrosion thining in carbon steel piping: Final report. Gerber, T.L.; Riccardella, P.C.; Kuo, A.Y.; Pitcairn, D.R. (Electric Power Research Inst., Palo Alto, CA (USA); Structural Integrity Associates, San Jose, CA (USA)). Jul 1988. 30p. Unlimited audience, publicly available. Research Reports Center, Box 50490 Palo Alto, CA 94303. Order Number TI88013632/JAW.

This document provides an overview of guidance and acceptance criteria for evaluation of carbon steel piping erosion/corrosion wall thinning. The guideline is based on Code design requirements and defines the degree of wall thinning (depth and extent) which can be safely left in service. A three-step evaluation process is proposed which includes a screening step to determine if further evaluation is warranted, comparison of general wall thinning with the design minimum wall thickness requirements and provides three alternative acceptance criteria for evaluating thinning in cases where the local wall thickness is less than the design minimum. This guideline should be of particular use to nuclear plant owners who are planning and conducting pipe wall thinning inspection programs.

46593 (INIS-BR—1151) Activities of Nuclebras in the area of reactor safety. Part 2. Reactor safety activities in the Nuclear Technology Brazilian Center from Nuclebras. Pinheiro, R.B. (NUCLEBRAS, Rio de Janeiro (Brazil)). 1986. 40p. (In Portuguese). (CONF-8608221—). NTIS (US Sales Only), PC A03/MF A01. Order Number DE88703554/JAW.

From Workshop on PWR reactor safety; Rio de Janeiro, Brazil (11 Aug 1986).

The Research and Development program in termohydraulic and reactor safety developed at CDTN is presented. (E.G.).

46594 (ORNL/TM—10645) DOS-HEATING6: A general conduction code with nuclear heat generation derived from DOT-IV transport calculations. Williams, M.L.; Yuecel, A.; Nadkarny, S. (Oak Ridge National Lab., TN (USA); Louisiana State Univ., Baton Rouge (USA)). May 1988. Contract AC05-84OR21400. 135p. NTIS, PC A07/MF A01; 1; GPO Dep. Order Number DE88013503/JAW.

The HEATING6 heat conduction code is modified to (a) read the multigroup particle fluxes from a two-dimensional DOT-IV neutron- photon transport calculation, (b) interpolate the fluxes from the DOT-IV variable (optional) mesh to the HEATING6 control volume mesh, and (c) fold the interpolated fluxes with kerma factors to obtain a nuclear heating source for the heat conduction equation. The modified HEATING6 is placed as a module in the ORNL discrete ordinates system (DOS), and has been renamed DOS-HEATING6. DOS-HEATING6 provides the capability for determining temperature distributions due to nuclear heating in complex, multi-dimensional systems. All of the original capabilities of HEATING6 are retained for the nuclear heating calculation; e.g., generalized boundary conditions (convective, radiative, finned, fixed temperature or heat flux), temperature and space dependent thermal properties, steady-state or transient analysis, general geometry description, etc. The numerical techniques used in the code are reviewed and the user input instructions and JCL to perform DOS-HEATING6 calculations are presented. Finally a sample problem involving coupled DOT-IV and DOS-HEATING6 calculations of a complex space-reactor configurations described, and the input and output of the calculations are listed. 10 refs., 11 figs., 6 tabs.

46595 Aging of electric motors in nuclear power plants. Subudhi, M.; Taylor, J.H. (Brookhaven National Lab., Upton, NY (USA)). *Transactions of the American Nuclear Society;* **55**: 272-273(1987). (CONF-8711195—).

From American Nuclear Society winter meeting; Los Angeles, CA, USA (15 Nov 1987).

Motor degradation due to aging and service wear decreases reliability and increases the potential for failure during nuclear plant accident and postaccident conditions. The impact of motor failures on plant safety is an important concern among the nuclear utilities and with the government agency regulating this industry. Economic impacts, relating to plant availability and safety as well as corrective maintenance, have prompted utilities to improve their maintenance programs to mitigate such aging effects. Despite the fact that modern motors are better and more sophisticated than older motors, and maintenance practices are more extensive, they still fail. Most motor failures described in the operating experience data bases had occurred during starting. The insulating system and bearing assemblies were the dominant failure modes, accounting for almost 70% of the reported failures. Monitoring the state of these two subcomponents, using cost-effective techniques, could eliminate many untimely failures and thus improve the overall system reliability and plant availability. The operating experience of these motors has revealed that a number of functional indicators are available, which could be used to monitor the condition of stator winding insulation and bearing assemblies. This study also has identified the predominant failure modes, causes, and mechanisms that are caused by the aging and service wear effects.

2203 Fuel Elements

46596 (AERE-R—12803) SINGAR 'A' and 'B': simplified models for fission gas release in transients. Small, G.J.; MacInnes, D.A. (UKAEA Harwell Lab. Materials Development Div.). Mar 1988. 25p. H.M. Stationery Office, London, price Pound 4.00.

The paper concerns the development of simple models based on the more complex SINGAR code, for fission gas release during transient heating. The simple models SINGAR 'A' and 'B' permit explicit variation of: ramp rate, burn up, temperature history, stoichiometry and grain size. SINGAR 'A' is the simplest formulation for calculating transient fission gas release, but the development of SINGAR 'B' has indicated the direction in which future development should proceed. (U.K.).

46597 Why reliability is the most important aspect of fuel design for a utility. Pilat, E.E. *Transactions of the American Nuclear Society;* **55**: 107(1987). (CONF-8711195—).

From American Nuclear Society winter meeting; Los Angeles, CA, USA (15 Nov 1987).

Official fuel design improvements have proliferated in recent years. The US Nuclear Regulatory Commission's 1985 report states that A wide variety of fuel design changes are being studied by domestic fuel vendors, the Electric Power Research Institute (EPRI), and the US Department of Energy (DOE). Perhaps some of this is in the nomenclature - what used to be called minor modifications are now called product lines. Nevertheless, the emphasis on the individuality of the different designs serves well to alert us to the fact that fuel design is still an art as well as a science, and that small changes in individual components can make significant changes in the overall operating characteristics. Yankee Atomic Electric Company tends to evaluate fuel designs by the way that they rate on the three R's of fuel performance: reliability, reliability, and reliability. Three reasons for this attitude are discussed.

46598 Utilities' nuclear fuel economic evaluation methods. Sonz, L.A. *Transactions of the American Nuclear Society;* **55**: 108(1987). (CONF-8711195—).

From American Nuclear Society winter meeting; Los Angeles, CA, USA (15 Nov 1987).

This paper presents the typical perceptions, methods, considerations, and procedures used by an operating electric utility in the economic evaluation of nuclear fuel preparation and utilization scenarios. The means given are probably not an exclusive review of those available, but are the author's recollection of systems employed to select and recommend preferable courses of action. Economic evaluation of proposed nuclear fuel scenarios is an important, but not exclusive, means of deciding on corporate action. If the economic evaluation is performed and coordinated with the other corporate considerations, such as technical and operational ability, electrical system operations management, tax effects, capital management, rates impact, etc., then the resultant recommendation may be employed to the benefit of the customers and, consequently, to the corporation.

46599 TACO3 - a best-estimate fuel pin thermal analysis code. Wesley, D.A.; Firth, K.J. *Transactions of the American Nuclear Society;* **55**: 118-119(1987). (CONF-8711195—).

From American Nuclear Society winter meeting; Los Angeles, CA, USA (15 Nov 1987).

Economics, limited facilities for spent fuel storage, and efficient utilization of current resources are incentives for extending the discharge burnup limits of nuclear fuel. Extended burnup operation, however, causes abnormal changes in fuel rods. These changes prompted the development of the TACO3 computer code. TACO3 is a best-estimate fuel pin thermal analysis code that was written to provide accurate predictions of fuel pin behavior from the beginning of life through extended burnups. The TACO3 model development effort was divided into three main categories: material, primary, and secondary models. A complete set of best-estimate fuel and cladding material relations was developed in the material model activity. The primary models are defined as those models that significantly affect the fuel temperature predictions while the secondary models have the greatest impact at extended burnups. In this paper, the authors discuss the TACO3 development in these areas and demonstrate the accuracy obtained in benchmark calculations.

2204 Control Systems

REFER ALSO TO CITATION(S) 46661

46600 (ENEA-RT-PEC—85-1) Automatic surveillance systems. A software device for operator support by means of real time simulation techniques. Bruschi, R.; Pallottelli, R. (ENEA, Rome (Italy)). 1985. 41p. (In Italian). NTIS (US Sales Only), PC A03/MF A01. Order Number DE88702849/JAW.

In this paper are presented studies and realization of a special tool, for supporting the console-operator, during normal or abnormal conditions of the plant. It has been realized by means of real-time simulation techniques and it is able: a) to diagnose plant-faults in real-time mode and, to allow the operator to detect the locations of the causes of the malfunctions; b) to supply the conditions where the plant is going, whether in normal or accidental evolution.

46601 (ENEA-RT-TIB—85-31) Application of multilevel flow modelling method for nuclear plant state identification. Businaro, T.; Di Lorenzo, A.; Meo, G.B.; Rabbani, M.I.; Rubino, E. (ENEA, Rome (Italy)). 1986. 46p. NTIS (US Sales Only), PC A03/MF A01. Order Number DE88702851/JAW.

With the advent of advanced digital techniques it has been rendered possible, necessity of which has long since been recognised, to develop a computer based man-machine interface and hance an expert system based on knowledge based decision making for operator support in the control rooms of nuclear plants. The Multilevel Flow Modelling method developed at RISO Laboratories, Denmark, has been applied in the present experiment to model Italian PEC reactor and to verify applicability of this method in plant state identification. In MFM method functional structure of a process plant is described in terms of a set of interrelated mass and energy flow structures on different levels of physical aggregation. 16 ref.

46602 (IYF-R—5-9-290) Automatic control system for in-reactor testing machines. Ashparov, T.B.; Vakher, M.S.; Malygin, V.B.; Pavlij, K.V.; Sulajmonov, M.; Turdybaev, S. (AN Uzbekskoj SSR, Tashkent. Inst. Yadernoj Fiziki). 1987. 8p. (In Russian). NTIS (US Sales Only), PC A02/MF A01. Order Number DE88703637/JAW.

The paper is devoted to the development of automatic control samples deformation and to the programme of necessary loading regimes in the process of reactor investigation of materials mechanical properties. 5 refs.; 2 figs.

46603 Evaluation of 'period-generated' control laws for the time-optimal control of reactor power. Bernard, J.A. (Nuclear Reactor Lab., The Massachusetts Institute of Technology, 138 Albany Street, Cambridge, MA (US)). *IEEE (Institute of Electrical and Electronics Engineers) Transactions on Nuclear Science;* **35**: No. 1, 888-893(Feb 1988). (CONF-871006—).

From 34. nuclear science symposium and 19. nuclear power systems symposium; San Francisco, CA, USA (21 Oct 1987).

Time-Optimal control of neutronic power has recently been achieved by developing control laws that determine the actuator mechanism velocity necessary to produce a specified reactor period. These laws are designated as the 'MIT-SNL Period-Generated Minimum Time Control Laws'. Relative to time-optimal response, they function by altering the rate of change of reactivity so that the instantaneous period is stepped from infinity to its minimum allowed value, held at that value until the desired power level is attained, and then stepped back to infinity. The results of a systematic evaluation of these laws are presented. The behavior of each term in the control laws is shown and the capability of these laws to control properly the reactor power is demonstrated. Factors affecting the implementation of these laws, such as the prompt

neutron lifetime and the differential reactivity worth of the actuators, are discussed. Finally, the results of an experimental study in which these laws were used to adjust the power of the 5 MWt MIT Research Reactor are shown. The information presented should be of interest to those designing high performance control systems for test, spacecraft, or, in certain instances, commercial reactors.

46604 **Research reactor I & C/electrical systems availability improvements.** Knell, K.C.; Maletz, J.J.; Meyer, W. *Transactions of the American Nuclear Society;* **55**: 194-195(1987). (CONF-8711195—).

From American Nuclear Society winter meeting; Los Angeles, CA, USA (15 Nov 1987).

The University of Missouri Research Reactor (MURR) currently has the highest power, highest neutron flux, and is the most often used US Nuclear Regulatory Commission licensed university research reactor in the United States. The reactor is required to operate 150 h/week and maintain an availability of 91% of total time. The university is experiencing difficulty with the operation of the instrumentation and control (I & C)/electrical systems, which results in excessive maintenance and reactor downtime. Although this is not a safety concern, it is becoming increasingly more difficult for the university to satisfy the availability requirements of the facility. To address this condition, an evaluation of the existing I & C/electrical system design was performed to identify modifications and improvements to increase the reliability and availability of the reactor. This paper describes the method that was used to identify the equipment and systems contributing to reactor scrams and unavailability, and the options considered for improvements in design, such as the application of redundancy and coincident logic. In addition, the systems and components were evaluated for replacement with digital-microprocessor-based systems to improve maintenance, operability, and human factors and to reduce reactor scrams.

2205 Environmental Aspects

REFER ALSO TO CITATION(S) 46411, 46596

46605 **(DP-MS—86-32) Wetland vegetation change detection using high resolution aircraft MSS [multispectral scanner] data.** Christensen, E.J.; Jensen, J.R.; Ramsey, E.W.; Mackey, H.E. Jr. (Savannah River Lab., Aiken, SC (USA)). 1986. Contract AC09-76SR00001. 37p. (CONF-8609381—1). NTIS, PC A03/MF A01; 1; GPO Dep. Order Number DE88014302/JAW.

From Fall conference of the American Society for Photogrammetry and Remote Sensing and American Congress on Surveying and Mapping; Anchorage, AK, USA (28 Sep 1986).

Portions of the Savannah River floodplain were evaluated for wetland vegetation change using high-resolution (5.6 x 5.6 meter pixel) aircraft multispectral scanner (MSS) data. Image distortion from aircraft movement prevented precise image-to-image registration in some areas. However, when small scenes were used (190 to 240 hectares), a first-order linear transformation provided registration accuracies less than or equal to one pixel. A larger area was successfully registered using a piecewise linear method. Five wetland classes and one transitional community were indentified and evaluated for change. Phenological differences and the variable distribution of vegetation limited wetland type discrimination. Using unsupervised methods and ground-collected vegetation data, overall classification accuracies ranged from 84 to 87 percent for each scene. A post-classification change analysis identified wetlands transformations in some areas. Cypress-tupelo swamp forest was commonly replaced by more thermally and flood-tolerant marsh species. In areas where cooling water releases were discontinued, invasion by scrub/shrub communities occurred. Results show that multi-date, high-resolution aircraft MSS data can be registered if small areas are used, and that wetland vegetation change can be accurately detected and monitored. 33 refs., 6 figs., 5 tabs.

46606 **(POO-M—1985-6) Further analysis of the point of view of the Dutch government with regard to the location sites for nuclear power plants. Study within the framework of the nuclear planning decision (PKB), 'Location sites nuclear power plants', October 1985 (Revised edition).** Eck, P. van; Koekebakker, P.H.; Tutuarima, W.H.; Vries, J. de. (Technische Univ. Delft (Netherlands). Afd. der Civiele Techniek). Oct 1985. 32p. (In Dutch). NTIS (US Sales Only), PC A03/MF A01. Order Number DE88703802/JAW.

This report presents the results of an analysis, performed by staff members of the Department of Civil Technology of the Technology University Delft, of the way of policy preparation and policy choices of the Dutch Government expressed in the Policy-plan Location Sites for Nuclear Power Plants. The analysis was motivated by the notion of the untransparent and unexpected way in which some special location sites, which have been abandoned already in the first selection, later still get involved in the judgement. In this analysis attention is predominantly directed to the judgement of the various sites with emphasis of the location Moerdijk. The analysis of the judgement process of the Government is explicitly based on the information given in the policy-plan itself, thus without adding other standards, criteria and location sites. 10 refs.; 3 figs.; tabs.

46607 **Ocean breeze monitoring network at the Oyster Creek Nuclear Plant.** Heck, W. *Transactions of the American Nuclear Society;* **55**: 90(1987). (CONF-8711195—).

From American Nuclear Society winter meeting; Los Angeles, CA, USA (15 Nov 1987).

The Oyster Creek Nuclear Generating Station (OCNGS) is located in New Jersey 10 km west of the Atlantic Ocean. Routine meteorological monitoring at the station has consisted of a single meteorological tower 120 m high and instrumented at the 10-m, 46-m, and 116-m levels. An analysis of 5 yr of data from this tower showed the OCNGS is affected by an ocean breeze ~ 1 day out of 4 during May through August. This suggested the need for meteorological monitoring in addition to the single met tower at OCNGS. As a result of the 1985 OCNGS meteorological monitoring study, GPU Nuclear established an ocean breeze monitoring network in the fall of 1986. It is a permanent part of OCNGS meteorological monitoring and consists of the same sites as used in the 1985 field study. Meteorological towers are located at the ocean site, the inland site, and at OCNGS. The ocean tower is 13 m (43 ft) high, the inland tower 10 m (33 ft), and the OCNGS tower 116 m (380 ft). Wind speed, wind direction, and temperature are measured on each tower; delta-temperature is also measured on the main tower. The instruments are calibrated in the spring, summer, and fall. The network is operated and maintained by GPU Nuclear Environmental Controls. The ocean breeze monitoring network and meteorological information system forms the basis for including the effects of the ocean breeze in OCNGS emergency off-site dose assessment.

46608 **Simulating sea breezes and plume concentrations with a puff-windfield model.** Ball, R.J. *Transactions of the American Nuclear Society;* **55**: 90-92(1987). (CONF-8711195—).

From American Nuclear Society winter meeting; Los Angeles, CA, USA (15 Nov 1987).

The purpose of the study simulating sea breezes and plume concentrations was to improve the modeling of accidental airborne radiation releases during sea breeze conditions. The model was developed for Northeast Utilities' Millstone Point nuclear generating station, which is located on Connecticut's Atlantic coast and experiences sea breeze conditions frequently. The model provides a three-dimensional simulation of the complex sea breeze circulation, including the return flow aloft, and yields concentration patterns consistent with the simulated wind flows.

46609 **Maintaining maximum valid data recovery from a meteorological monitoring system.** Rosenmeyer, A.J. *Transactions of the American Nuclear Society;* **55**: 92-93(1987). (CONF-8711195—).

From American Nuclear Society winter meeting; Los Angeles, CA, USA (15 Nov 1987).

Meteorological monitoring at a nuclear plant is mandatory and must satisfy specific US Nuclear Regulatory Commission re-

quirements. Meteorological monitoring requirements have changed dramatically since the Three Mile Island Nuclear Plant accident, and it has become an integral part of nuclear emergency preparedness. The manner in which a meteorological monitoring network at the Indian Point Nuclear Power Plant is being maintained assures a maximum value of valid data recovery for all meteorological parameters. Only data that are reliable and valid can be used for making the proper decisions for safety in the event of an on-site plant emergency. The local weather conditions must be known at all times in the event of a radioactive release, so that plume dispersion can be satisfactorily evaluated and protective action recommendations can be taken. It an evacuation is deemed necessary, this evacuation must take place in the proper direction to fully protect the general public. By following the guidelines developed for use at the Indian Point Nuclear Power Plants valid data recovery well in excess of 95% has been achieved during the plants 15 yr of operation.

46610 Preliminary meteorological forecasting strategy to support nuclear emergency preparedness. Klausmann, A.M. (New York Power Authority, White Plains (USA)). *Transactions of the American Nuclear Society;* **55**: 93(1987). (CONF-8711195—).

From American Nuclear Society winter meeting; Los Angeles, CA, USA (15 Nov 1987).

A meteorological forecasting strategy designed specifically for supporting emergency preparedness at nuclear power plants is described in this paper. The objective of such a strategy is to provide the framework from which utility meteorologists can develop and implement an effective meteorological forecasting capability at their facilities. The strategy must provide a systematic approach to the analysis of meteorological conditions, preparation of weather forecasts, and utilization of this information to support emergency response systems. The meteorological forecasting strategy was designed to satisfy three principal requirements. First, it must provide the basic logic that allows one to efficiently assemble and interpret the large volumes of meteorological information available at any given time. Second, it must direct the meteorologist's attention to those phenomena and weather elements that are most important to the emergency response system. Third, it must reduce the subjectivity inherent in meteorological forecasting.

46611 Numerical computations on turbulent dispersion in complex terrain. Liu, K.K.; Chieng, C.C. (National Tsing Hua Univ. (Taiwan)). *Transactions of the American Nuclear Society;* **55**: 94-95(1987). (CONF-8711195—).

From American Nuclear Society winter meeting; Los Angeles, CA, USA (15 Nov 1987).

In this study, a hydrodynamic plume model and the best-known k-epsilon two-equation turbulence model of Launder et al. are employed with a computer program, which was developed to solve the unsteady, three-dimensional, coupled partial differential equations of mass, momentum, energy, mass fraction, and turbulent properties. The initial conditions and the relevant boundary conditions of complex topography are supplied by numerical models. The flow fields and the concentrations of the radioactive gases can be obtained in detail. The major focus of this work is on the effects of the complex terrain, in particular the rugged terrain surrounding Kuosheng Nuclear Power Plant. This plant is next to the very populated city of Taipei, and the local topography and surface changes tend to produce considerable distortions in the transport, diffusion, deposition, and accumulation of plume materials. The present study suggests that this model is a candidate for assessing environmental effects and preparing an emergency plan for the future reactor site. Its application to the complex terrain is very successful and provides valuable information.

2206 Research, Test, And Experimental Reactors

REFER ALSO TO CITATION(S) 46411, 46604, 46643

46612 (ENEA-RT-PAS—87-11) Design of the experimental apparatus to obtain a thermal neutron beam, intermediate-energy neutrons (2-144 KeV) and high-energy photons (6 MeV) by means of the Triga reactor at the ENEA Casaccia center. Laitano, R.F.; Mancini, C. (ENEA, Rome (Italy)). Sep 1987. 25p. (CONF-8609251—5). NTIS (US Sales Only), PC A03/MF A01. Order Number DE88754221/JAW.

From 29. plenary meeting of the European Working Group on irradiation technology; Karlsruhe, F.R. Germany (24 Sep 1986).

Neutron beams in the energy range between 2 and 150 KeV can be obtained by suitably filtering the neutrons in the beam tubes of a nuclear research reactor. This method has been applied at the NBS and PTB reactors. Neutron beams in this energy range are very important to determine the response of neutron detectors and particularly of dose-equivalent meters in an energy range where neutron calibration sources are not easily available. The details of filter design depend on the reactor considered. In this paper, the characteristics of the filters to be applied to the TRIGA reactor at the ENEA Casaccia Center are outlined. Scandium, iron and silicon are the basic filter materials used to obtain neutron beams with energies of 2, 24.5 and 144 KeV, respectively, in different beam tubes of the reactor. The paper also describes the characteristics of the system adopted to obtain a thermal neutron beam and a 6 MeV photon beam by means of the (n,(g,n)) reaction on a titanium target.

46613 (JINR—13-87-564) Study of moving reflector vibrations. IBR-2 reactor energy start-up. Pepelyshev, Yu.N. (Joint Inst. for Nuclear Research, Dubna (USSR). Lab. of Neutron Physics). 1987. 21p. (In Russian). NTIS (US Sales Only), PC A03/MF A01. Order Number DE88703658/JAW.

The results on the experimental study of occasional vibrations of the IBR-2 moving reflectors are given. The influence of the moving reflector structure, the level of their axial and phase oscillations and periods of reflector rotation on the external reactivity fluctuations is analysed. The methods of the statistical analysis of the stationary bicomponent time series are used for experimental data processing. It is shown that at the period of the IBR-2 energy start-up the uncontrolled reactivity fluctuations due to the moving reflector vibrations were rather insignificant (4.5+-2.7x10/sup -6/ δ K/K). The construction of the reactivity modulator with the moving reflector as trident provides the regular reactor operation in the mean power range of 0-2 MeV. 6 refs.; 10 figs.; 5 tabs.

46614 (JINR—13-87-565) On a possibility to identify the IBR-2 reactor anomalous states by power noises. Pepelyshev, Yu.N. (Joint Inst. for Nuclear Research, Dubna (USSR). Lab. of Neutron Physics). 1987. 8p. (In Russian). NTIS (US Sales Only), PC A02/MF A01. Order Number DE88703659/JAW.

The possibility of the identification of the anomalous state of the IBR- reactor and the system of the moving reflectors by power noises is examined. As a concrete example, the situation when the development of one latent defect in the moving reflectors system leads to the reactor shutdown is analysed. The simplest algorithm of the control of the general moving reflector by power noises is given. It is shown that the realization of the given algorithm on a mini-computer makes it possible to realize the moving system control in the conditions near to the real time ones. 3 refs.; 4 figs.; 1 tab.

46615 (KIYI—87-7) On the capabilities to enhance effectiveness of the WWR-M test reactor. Malers, Yu.P. (AN Ukrainskoj SSR, Kiev. Inst. Yadernykh Issledovanij). 1987. 18p. (In Russian). NTIS (US Sales Only), PC A03/MF A01. Order Number DE88703792/JAW.

The work teals with possible ways rise effectiveness of WWR-M test reactor. Optimal reactor criteria operation and reactor core assembling characteristics are presented. Recommendations concerning heat assemblies distribution at overloading are considered. 10 refs.; 4 figs.

40616 (KIYI—87-8) Specification of /sup 235/U burn-up values in fuel assemblies of WWR-M reactor with the aid of incomplete history of refuelings. Malers, Yu.P. (AN Ukrainskoj SSR, Kiev. Inst. Yadernykh Issledovanij). 1987. 15p. (In Russian). NTIS (US Sales Only), PC A03/MF A01. Order Number DE88703793/JAW.

A problem of reliability of an information about burn-up distribution in nuclear WWR-M core is considered and a method to specify this information of the least 12 reactor reloadings is made and as a result enough reliable data of burn-up values are obtained. 4 refs.; 4 figs.

40617 (WHC-EP—0123) The reliability-centered maintenance study at the Fast Flux Test Facility. Kessler, S.F. (Westinghouse Hanford Co., Richland, WA (USA)). Jan 1988. Contract AC06-87RL10930. 20p. NTIS, PC A03. Order Number DE88014649/JAW.

A reliability-centered maintenance (RCM) program was applied to two Fast Flux Test Facility (FFTF) systems to evaluate this method for improving the equipment reliability and reducing maintenance costs. This technique is a systematic approach to failure analysis and maintenance task development. The RCM method was originally developed by the airline industry to reduce maintenance costs and improve reliability and it has since been adopted by the military. The Electric Power Research Institute (EPRI) has completed two pilot studies with a third in progress to determine the RCM applicability to the commercial nuclear power industry. These studies showed that the RCM methodology could be beneficial to the nuclear power industry. The EPRI study performed at the McGuire nuclear power station (EPRI 1986) was used as the model for the FFTF study.

40618 (WHC-SA—0016) FFTF [Fast Flux Test Facility] Fission Gas Monitor Computer System. Hubbard, J.A.; Taylor, G.T. (Westinghouse Hanford Co., Richland, WA (USA)). Aug 1987. Contract AC06-87RL10930. 14p. (CONF-870837—2). NTIS, PC A03/MF A01; 1; GPO Dep. Order Number DE88014613/JAW.

From 13. American Nuclear Society international meeting on nuclear power plant operation; Chicago, IL, USA (30 Aug 1987).

The Fast Flux Test Facility (FFTF) is a liquid-metal-cooled, fast neutron test reactor located on the Hanford Site. A dual computer system has been developed to monitor the reactor cover gas to detect and characterize any fuel or test pin fission gas releases. The system acquires gamma spectra data, identifies isotopes, calculates specific isotope and overall cover gas activity, presents control room alarms and displays, and records and prints data and analysis reports. The Fission Gas Monitor System (FGMS) integrates commercially available hardware and software, providing a reliable and easily maintained system. The design provides extensive automation of previous manual operations, reducing the need for operator training and minimizing the potential for operator error. The dual nature of the system allows either system A or B to be taken out of service for periodic tests or maintenance without interrupting the overall system performance. A control room color display tracks the specific activity of selected isotopes, provides alarms when a fission gas release is detected, and characterizes the nature and source of the release. Sources in the FFTF that can be uniquely identified include fuel pins, control rod absorber pins, and N- and M-type test pins which are irradiated in the reactor Materials Open Test Assembly (MOTA). The principal method used to characterize the source of the assembly leak involves the analysis of four isotopes, namely Xe-125, Xe-133, Xe-135, and Kr-85m, and the ratios of Xe-133/Xe-135 and Xe-133/Kr-85m. The computer analysis also compensates for Xe-133 buildup which reaches a saturation value after about 20 days of full-power operation. In addition, the computer calculates the specific activity of 20 isotopes which are used to help perform a detailed analysis of leaks from fuel assemblies.

40619 (WHC-SA—0125) Fracture behavior of ferritic steels irradiated at 50{degree}C in the High-Flux Isotope Reactor (HFIR). Huang, F.H. (Westinghouse Hanford Co., Richland, WA (USA)). Jun 1988. Contract AC06-87RL10930. 29p. (CONF-880613—16). NTIS, PC A03/MF A01; 1; GPO Dep. Order Number DE88013673/JAW.

From 14. international symposium on effects of radiation on materials; Andover, MA, USA (27 Jun 1988).

Ferritic steels have been selected as candidate materials for first-wall applications in fusion reactors, because of their high resistance to swelling and low thermal expansion coefficient. To characterize the fracture behavior of these materials influenced by both displacement damage and transmutation produced helium at levels relevant to fusion reactor irradiation conditions, the fracture toughness of HT9 and 9Cr-1Mo irradiated to 10–20 dpa at 50{degree}C was evaluated using electric potential single specimen techniques. Circular compact tension specimens were tested at temperatures ranging from room temperature to 450{degree}C. The single specimen method was employed to minimize the number of specimens required to save irradiation space and to meet requirements for testing samples with a prototypic component thickness. Specimens of HT9 doped with 1 and 2% nickel to increase helium production during High Flux Isotope Reactor (HFIR) irradiation were also tested.

40620 Enhancement of the RPI reactor facility by HEU/LEU conversion. Harris, D.R.; Rodriguez-Vera, F.; Shin, S.T. *Transactions of the American Nuclear Society;* **55**: 182-184(1987). (CONF-8711195—).

From American Nuclear Society winter meeting; Los Angeles, CA, USA (15 Nov 1987).

The Reactor Critical Facility (RCF) at Rensselaer Polytechnic Institute (RPI) operated for almost a quarter century with highly enriched uranium (HEU) fuel in stainless steel clad. Although the RCF was used originally by the American Locomotive Company for critical experiments in support of the Army Package Power Reactor Program, RPI has operated the facility primarily for teaching purposes because the HEU fuel was not of current interest for industry critical experiments. The RCF has now been converted to 4.81 wt% enriched high-density UO_2 fuel clad in ~ 1-cm-diam stainless steel tubes. This low-enriched uranium (LEU) fuel is relevant for light water reactors (LWRs) in view of the current trend toward high-exposure fuel with enrichment near 5 wt%. Critical experiment information is deficient in this area. The use of stainless steel cladding in the RCF rather than the Zircaloy cladding normally used in the LWR industry is a reasonably well understood perturbation. Thus, critical experiments are being carried out at the RCF in addition to the normal training functions. The RCF is the only facility in the US now available for conducting critical experiments in support of the LWR power industry, although several such facilities are in operation overseas.

40621 Fuel conversion and upgrade of the Ohio State University Research Reactor. Talnagi, J.W. (Ohio State Univ., Columbus (USA)). *Transactions of the American Nuclear Society;* **55**: 184(1987). (CONF-8711195—).

From American Nuclear Society winter meeting; Los Angeles, CA, USA (15 Nov 1987).

The Ohio State University Research Reactor (OSURR) is being converted to use low-enrichment uranium-silicide (U_3Si_2) fuel. Concurrent with conversion, the reactor will be upgraded to higher power. Funding is provided by the university and the US Dept. of Energy (DOE). Work began in August 1985 and is in the licensing and engineering phase. The project was undertaken in response to US Nuclear Regulatory Commission (NRC) and intervenor actions regarding fuel conversion of research reactors and the desire to enhance the research and educational capabilities of the OSURR. Project activities were divided into three areas. First, analytical studies to assess the performance of the OSURR fueled with low-enrichment uranium (LEU) were performed. These included neutronic and thermal-hydraulic analyses of core behavior under normal and accident conditions. Coolant behavior in the reactor pool was analyzed to support cooling system design. Based on the analytical studies and other data, a safety analysis report (SAR) was written and technical specifications prepared. Engineering activities, including design and installation of a cooling system, comprise the third area of project activity.

40622 TRIGA reactor relocation at the University of Texas at Austin. Klein, D.E. (Univ. of Texas, Austin (USA)). *Transactions of the American Nuclear Society;* **55**: 185(1987). (CONF-8711195—).

From American Nuclear Society winter meeting; Los Angeles, CA, USA (15 Nov 1987).

The University of Texas at Austin (UT) is in the process of relocating its TRIGA reactor facilities. This undertaking includes the construction of a new reactor building with laboratories and offices and the decommissioning of the existing facility. The main campus of The University of Texas at Austin is becoming congested, and several major research projects (mostly engineering) are moving to the Balcones Research Center ~ 8 miles from the main campus. The process of constructing a new nuclear facility in today's regulatory environment can best be described as challenging. Fortunately, research reactor licensing is not as complicated as that for commercial power facilities, although many procedures are similar. Unfortunately, the university has its own challenging procedures for building construction. Considerable time has been expended coordinating the US Nuclear Regulatory Commission (NRC) and UT licensing and construction activities. The paper summarizes the major steps and dates accomplished. The new reactor facility at the Balcones Research Center will enhance the universities ability to carry on teaching and research activities. The increased power level and the Mark II arrangement will allow us to perform new and additional projects. Considerable time and effort were devoted by the Nuclear Engineering Laboratory staff to ensure that the facility would provide educational and research flexibility over the next several years.

46823 **Conversion and upgrade of the Rhode Island Nuclear Science Center Reactor.** DiMeglio, A.F. *Transactions of the American Nuclear Society;* 55: 185-186(1987). (CONF-8711195—).

From American Nuclear Society winter meeting; Los Angeles, CA, USA (15 Nov 1987).

The Rhode Island Atomic Energy Commission, an agency of the state of Rhode Island, has operated a 2-MW swimming pool research reactor at the Rhode Island Nuclear Science Center (RINSC) since 1964. The reactor, which utilizes plate-type materials test reactor fuel elements, is used primarily by facility and research scientists from the University of Rhode Island for neutron scattering, using the beam tubes and activation analysis programs that use irradiation facilities both inside and adjacent to the core. Along with most other university research reactors, the RINSC reactor is now required, pursuant to 10CFR50.64, to convert from the use of high-enrichment uranium fuel elements to the use of low-enriched uranium (LEU) fuel elements. It is apparent that the US Nuclear Regulatory Commission mandate to convert the RINSC reactor to the use of LEU will result in a new core, designed to use the standard fuel plate and at the same time enhance the available neutron flux and spectrum for research using neutron scattering and activation analysis.

46824 **Upgrade of the University of Missouri Research Reactor.** McKibben, J.C.; Edwards, C.B.; Banerjee, A.K. (Univ. of Missouri, Columbia (USA)). *Transactions of the American Nuclear Society;* 55: 186-188(1987). (CONF-8711195—).

From American Nuclear Society winter meeting; Los Angeles, CA, USA (15 Nov 1987).

The University of Missouri Research Reactor (MURR) is enhancing the research, education, and service capabilities of the facility through a five-part upgrade. The existing reactor is a 10-MW pressurized loop type, already operating at a 92% availability to support demand from researchers and the industry. The upgrade is focused to meet the increasing demand for more neutrons and higher specific activity radioisotopes, especially for the biomedical community, cold neutrons, and expanded laboratory and office space. The upgrade includes an extended-life fuel element, a power increase, instrument and control and electrical system upgrade, a cold neutron source (CNS), and a building addition.

46825 **National Bureau of Standards Cold Neutron Research Facility.** Carter, R.S. *Transactions of the American Nuclear Society;* 55: 188-190(1987). (CONF-8711195—).

From American Nuclear Society winter meeting; Los Angeles, CA, USA (15 Nov 1987).

In 1984 a National Academy of Sciences committee was set up to review the need for major facilities in the area of materials and condensed matter science. The report specifically mentioned the National Bureau of Standards Reactor (NBSR) as one of the places that should develop a cold neutron research facility (CNRF). NBS was able to obtain funding from congress to develop the NBS CNRF. The facility will cost approximately $25,000,000, including the guide hall, ten major instruments, and eight guide tubes. The cost does not include the cold source itself, which was funded separately. The cold source configuration is shown. This project has been funded to provide a national center for neutron research. Some fraction (one-third to two-thirds) of all the new facilities will be made available to outside users at no charge. The facilities will be staffed adequately to provide needed assistance to outside users to assure that they can perform their experiments effectively and efficiently. The prioritization of outside proposals will be performed by an independent review committee that will base their recommendations on the scientific merit of each proposal.

46826 **Neutronic analysis of the conversion of HEU to LEU fuel for a 5-MW MTR core.** Pazirandeh, A.; Bartsch, G. *Transactions of the American Nuclear Society;* 55: 191-192(1987). (CONF-8711195—).

From American Nuclear Society winter meeting; Los Angeles, CA, USA (15 Nov 1987).

In recent years, due to cessation of highly enriched uranium (HEU) fuel supply, practical steps have been taken to substitute HEU fuel in almost all research reactors by medium-enriched uranium or low-enriched uranium (LEU) fuels. In this study, a neutronic calculation of a 5-MW research reactor core fueled with HEU (93% ^{235}U) is presented. In order to assess the performance of the core with the LEU (< 20%) fuel replacement, while keeping fuel element geometry nearly unchanged, several different ^{235}U loadings were examined. The core consists of 22 standard fuel elements (SFEs) and 6 control fuel elements (CFEs). Each fuel elements has 18 curved plates of which two end plates are dummies. Initial ^{235}U content is 195 g ^{235}U/SFE and 9.7 g ^{235}U/CFE or /PFE. In all calculations the permitted changes to the fuel elements are (a) 18 active plates per SFE, (b) fuel plates assumed to be flat, and (c) 8 or 9 active plates per CFE.

46827 **Major maintenance outages in a nonpower reactor environment.** Vernetson, W.G.; Whaley, P.M. (Univ. of Florida, Gainesville (USA)). *Transactions of the American Nuclear Society;* 55: 192-194(1987). (CONF-8711195—).

From American Nuclear Society winter meeting; Los Angeles, CA, USA (15 Nov 1987).

The purpose of this work was to restore reliable operation of a midsize nonpower research and training reactor within the financial and manpower constraints of a university reactor facility and to establish the experience base needed to address large maintenance outages within existing resource limitations for future applications. The scenario for and the results of a major forced outage for a recurring failure in the control blade drive system are presented to demonstrate major differences in maintenance outages between power and nonpower utility versus university reactor outages. The University of Florida Training Reactor (UFTR) is a 100-kW light-water-cooled, graphite and light-water-moderated modified Argonaut-type reactor, which utilizes 93% enriched materials test reactor type of fuel. The results of this work demonstrates that a major outage of nearly 6 months' duration has restored the UFTR control blade drive system to nearly original conditions and demonstrated QA program effectiveness while maintaining a viable educational program. In addition, the experience with this outage assures that a future fuel conversion with design changes can be undertaken successfully within the unique restrictions of a nonpower reactor environment.

46828 **Fuel element gamma scanning at the Oak Ridge Research Reactor.** Hobbs, R.W. (Oak Ridge National Lab., TN (USA)). *Transactions of the American Nuclear Society;* 55: 195-197(1987). (CONF-8711195—).

From American Nuclear Society winter meeting; Los Angeles, CA, USA (15 Nov 1987).

In January 1986, a demonstration program was begun at the Oak Ridge Research Reactor (ORR) to convert operations from high-enrichment uranium fuel to the newly developed U_3Si_2 low-enrichment fuel. A primary program objective is to validate neutronics calculations conducted by the Reduced Enrichment in Re-

search and Test Reactors Program at Argonne National Laboratory. Accordingly, a new method for determining core-power distribution has been developed. The method is based on gamma-ray spectroscopy measurements to determine the relative levels of ^{140}La in the fuel elements after each operating cycle. The measurement and data analyses are described and a comparison of measured and diffusion theory calculated values of the core-power distribution is presented in this paper.

46629 Quality assurance and spent-fuel shipments for research reactors. Wang, J.C.; Bell, M.; Brown, D.; Raby, T. *Transactions of the American Nuclear Society;* **55**: 197(1987). (CONF-8711195—).

From American Nuclear Society winter meeting; Los Angeles, CA, USA (15 Nov 1987).

Recent US Nuclear Regulatory Commission (NRC) inspection frequencies of commercial power plants' spent-fuel shipments have been approaching nearly 50%. The research reactor community, with its more limited resources, must also comply with the same requirements for spent-fuel shipments as those for commercial power facilities. The purpose of this paper is to describe the experience of the US National Bureau of Standards Reactor (NBSR) in shipping spent fuel with respect to the most recent changes in the quality assurance, licensing, and transportation requirements of regulatory agencies.

46630 Overview of reduced-enrichment fuels - development. Snelgrove, J.L. (Argonne National Lab., IL (USA)). *Transactions of the American Nuclear Society;* **55**: 274-276(1987). (CONF-8711195—).

From American Nuclear Society winter meeting; Los Angeles, CA, USA (15 Nov 1987).

The US Reduced Enrichment Research and Test Reactor (RERTR) Program was established in 1978 to provide the technical means to operate research and test reactors with low-enrichment uranium (LEU) fuels without significant penalty in experiment performance, operation costs, component modifications, or safety characteristics. A large increase in ^{235}U is required to reduce the enrichment, and a 10 to 15% increase in ^{235}U is required to compensate for the extra absorption in ^{238}U. The additional uranium can be accommodated by redesigning the fuel element to increase the fuel volume fraction in the reactor core and/or by increasing the uranium density in the fuel meat. Since fuel element redesign coupled with the highest density fuel available in 1978 is sufficient for only a few reactors, a fuel development and testing effort was begun to qualify much higher density fuels. The greatest emphasis has been on plate-type fuels, since plate-type reactors are the largest users of highly enriched uranium (HEU). In addition to the RERTR program's work with plate-type dispersion fuels, the CEA developed and tested the caramel fuel, consisting of sintered UO_2 wafers in Zircaloy-clad plates; GA Technologies developed highly loaded UZrH/sub x/ fuel for TRIGA reactors and tested it in cooperation with the RERTR Program; and Atomic Energy of Canada Ltd. developed and tested rod-type uranium silicide-Al dispersion fuel. The dispersion fuels were irradiated to high burnups to establish their limits of usability. A whole-core demonstration has been conducted in the ORR using 4.8 Mg U/m^3 U_3Si_2 dispersion fuel. Twenty-nine elements have achieved average burnups in excess of 40%.

46631 Final qualification testing results for TRIGA low-enriched uranium fuel. West, G.B.; Simnad, M.T.; Copeland, G.L. *Transactions of the American Nuclear Society;* **55**: 276-277(1987). (CONF-8711195—).

From American Nuclear Society winter meeting; Los Angeles, CA, USA (15 Nov 1987).

Following the adoption of policies by the US government and other fuel supplier nations to limit, with few exceptions, export of fuels to those enriched to $< 20\%$ in ^{235}U, GA Technologies undertook, starting in 1976, a rigorous program to develop uranium zirconium-hydride fuels with high uranium concentrations up to 3.7 g U/cm^3, while limiting the enrichment to $< 20\%$ in ^{235}U. By increasing the uranium concentration from 8.5 to 45 wt% and by including erbium as a burnable poison, the long reactivity lifetime of the high-enriched uranium cores has been preserved. The achieved purpose of these low-enriched uranium (LEU) fuels was also to preserve all the unique safety features of the TRIGA fuel system - prompt negative temperature coefficient of reactivity, high fission product retentivity, chemical stability when quenched from high temperatures in water, and dimensional stability over a broad range of operating temperatures.

46632 Testing of full-sized reduced-enrichment elements in the ORR. Copeland, G.L.; Snelgrove, J.L. (Oak Ridge National Lab., TN (USA)). *Transactions of the American Nuclear Society;* **55**: 277-278(1987). (CONF-8711195—).

From American Nuclear Society winter meeting; Los Angeles, CA, USA (15 Nov 1987).

Experimental high-density, reduced-enrichment fuel elements were irradiated in the Oak Ridge Research Reactor (ORR) to confirm their expected satisfactory performance in this medium-powered research reactor. This expectation of good performance was based on previous irradiations of miniature-sized plates in this and other reactors. A total of 21 elements were irradiated as described in the paper. These elements were fabricated by commercial manufacturers and, except where noted, were identical in appearance to the standard highly enriched ORR element that contains 19 curved plates. The elements were shuffled to several positions in the reactor during the course of their irradiation, similar to the handling of regular elements. The 13 plate elements were placed in low-flux positions during their initial testing due to their higher metal/water ratios. All of the elements were irradiated to the burnup normally achieved by typical ORR elements of $\sim$ 50% depletion of the original ^{235}U in the element. Some elements of each type were extended beyond this burnup to average depletions of 72 to 82%. The elements were periodically inspected for coolant channel thickness between irradiation cycles to provide early detection of excessive plate swelling or warpage. No problems were detected. The elements underwent postirradiation examination (PIE) at the High Radiation Level Examination Laboratory at Oak Ridge National Laboratory. All of the elements were judged to have performed satisfactorily during irradiation based on the PIE.

46633 Postirradiation examination of higher uranium density fuels at JAERI. Futamura, Y.; Yamamoto, A.; Shirai, E.; Oyamada, R.; Saito, M.; Adachi, M.; Sakai, H. *Transactions of the American Nuclear Society;* **55**: 279-280(1987). (CONF-8711195—).

From American Nuclear Society winter meeting; Los Angeles, CA, USA (15 Nov 1987).

A reduced enrichment program for research and test reactor fuels at Japan Atomic Energy Research Institute (JAERI), in which the JRR-2 and Japan Material Testing Reactor (JMTR) are to be converted to the use of medium-enriched uranium (MEU) (45% enriched uranium) aluminide fuels and the JRR-3 and JRR-4 to the use of low-enriched uranium (LEU) (19.5% enriched uranium) aluminide fuels is in progress or has been completed. Further core conversion of the JMTR to the use of LEU silicide fuels with burnable poison is being studied.

46634 Irradiation behavior of intermetallic uranium compounds used as fuel for research and test reactors. Hofman, G.L. (Argonne National Lab., IL (USA)). *Transactions of the American Nuclear Society;* **55**: 280-282(1987). (CONF-8711195—).

From American Nuclear Society winter meeting; Los Angeles, CA, USA (15 Nov 1987).

The majority of research and test reactors around the world employ aluminum fuel element designs that contain dispersed powders of uranium compounds as fuel. Specifically, two compounds are used, the uranium oxide U_3O_8 and an uranium aluminide mixed phase composed of the intermetallic compounds UAl_2, UAl_3, and UAl_4, all made with highly enriched uranium (HEU), i.e., 93% ^{235}U. The reduction of ^{235}U enrichment to below 20%, to so-called low enriched uranium (LEU), required the use of higher density fuels for those applications where simply increased fuel loading was not feasible. Fuel-dispersant loading is in practice limited to $\sim$ 45 vol%. Fuel development in the Reduced Enrichment Research and Test Reactor Program has focused on uranium silicides (U_3Si and U_3Si_2) as the most promising high-density fuels. The compounds U_6Fe and U_6Mn as well as U_3Si containing some aluminum or copper were tested in search of stable high-density fuel. Some properties of the traditional and newly tested fuels are shown. All fuels were tested in the Oak Ridge Research Reactor in the form of

miniature fuel plates. The irradiation performance capability of fuel plates is determined by the extent of plate thickness increases caused by fuel/aluminum interaction and irradiation-induced swelling of the fuel. The fuel swelling obtained with immersion density measurements is shown.

46635 **Unirradiated characteristics of U-Si alloys as dispersed-phase fuels.** Domagala, R.F.; Wiencek, T.C. (Argonne National Lab., IL (USA)). *Transactions of the American Nuclear Society;* **55**: 282-283(1987). (CONF-8711195—).

From American Nuclear Society winter meeting; Los Angeles, CA, USA (15 Nov 1987).

To satisfy the power demands of many research reactors, a new low-enriched uranium fuel with a high density and uranium content was needed. Any fuel must be compatible with aluminum and its alloys so that it may be fabricated as a dispersed-phase in aluminum alloy and aluminum matrix plate-type elements following, as nearly as possible, established commercial manufacturing techniques. The U-Si and U-Si-Al alloys at or near the composition of U_3Si were immediately attractive because of work documented by Canadian researchers. The paper illustrates the U-Si system. All intermediate phases, within the experimental ability to define them, are line compounds. For the goals of the Reduced Enrichment Research and Test Reactor Program, attention has focused on U_3Si (3.9 wt% Si) and U_3Si_2 (7.3 wt% Si) and compositions between these limits. Densities and hardness for as-arc-cast and heat-treated ingots in this composition range are shown. Photomicrographs corresponding to these compositions and conditions have been published. Because of its higher uranium content and density, U_3Si was the more attractive candidate fuel even though a prolonged heat treatment is required to complete the peritectoid reaction. The U_3Si_2 has a tightly bonded tetragonal structure with Si-Si bonds, whereas U_3Si has a less tightly bonded crystal (cubic above 765°C, tetragonal below) with no Si-Si bonds. As others have noted, U_3Si_2 has performed better than U_3Si in an irradiation environment.

46636 **Reduced-enrichment fuels at CERCA.** Fanjas, Y.R. *Transactions of the American Nuclear Society;* **55**: 283-284(1987). (CONF-8711195—).

From American Nuclear Society winter meeting; Los Angeles, CA, USA (15 Nov 1987).

Since the beginning of the Reduced Enrichment for Research and Test Reactors Program in 1978, CERCA has significantly contributed to the development of high-density fuels, allowing the use of reduced-enrichment uranium in reactors. The CERCA contribution has been of two kinds: (1) development of the fabrication technology for various types of high-density fuels (UAl/sub x/, U_3O_8, U_3Si_2, U_3Si, and U_3Si/sub x/; (2) production of full-sized fuel elements for irradiation in several reactors (in the United States, Europe, and Japan) to test the new fuels. This paper presents the fuel development status at CERCA from the viewpoints of fabrication technology and irradiation testing. It brings to light the new results obtained during the past year.

46637 **Characterization and development of U_3Si/sub x/ fuel - a manufacturer's perspective.** Garner, G.L.; Bogacik, K.E.; King, J.E. *Transactions of the American Nuclear Society;* **55**: 284-285(1987). (CONF-8711195—).

From American Nuclear Society winter meeting; Los Angeles, CA, USA (15 Nov 1987).

The Babcock and Wilcox Company (B & W) is engaged in the production of proliferation-resistant fuels for domestic and foreign research and test reactors. The decrease in ^{235}U enrichment from $>$ 90 to $<$ 20% in these fuels, requires that a greater amount of uranium be contained in the reactor fuel elements. The high uranium-dense fuel currently in use is the aluminum matrix plus U_3Si_2 dispersion alloy. The characteristics of this silicide fuel (from both a fabricability and operational viewpoint) has been well studied and documented in recent years. Full-sized demonstration elements to evaluate the performance of an even higher density fuel are currently being fabricated. A two-phase uranium-silicon alloy with a composition between the equilibrium U_3Si and U_3Si_2 phases has been selected. A characterization of this U_3Si/sub x/ fuel (U_3Si/sub x/ is a convenient notation for silicon content of 5.5 wt% nominal) has been performed at B & W and is the subject of this paper.

46638 **Correlation between annealing and irradiation behavior of dispersion fuels.** Wiencek, T.C.; Domagala, R.F. (Argonne National Lab., IL (USA)). *Transactions of the American Nuclear Society;* **55**: 285-286(1987). (CONF-8711195—).

From American Nuclear Society winter meeting; Los Angeles, CA, USA (15 Nov 1987).

Studying the effects of annealing of scaled-down aluminum matrix dispersion fuel plates is an important part of the data base for fuel performance. One of the most critical aspects of fuel performance is the stability of a fuel/matrix dispersion, which is usually measured by volumetric changes of the fuel zone. The preferred response of any fuel under irradiation would be no change in volume or a small, steady predictable change. These volume changes decrease the cooling gap channels and restrict the useful life of an element. Previous studies have defined the degree of volumetric change in current high-loading uranium silicide test reactor fuels. It has been demonstrated that some fuels behave well under irradiation, while others go into a breakaway swelling mode. A correlation has been proposed that fission-induced amorphization is responsible for the instability of the fuel and that such transformations can be predicted by the thermodynamic properties of the fuel. To complement this theory, it is proposed that annealing studies may be used as a screening test for new fuels for which no thermodynamic properties have been measured and/or no irradiation data are available. Irradiation performance could be estimated faster and without the expense of irradiating the fuels under investigation.

46639 **ZORITA fuel performance project evaluation with COMETHE III-L.** Montgomery, R.O.; Billaux, M. (Texas A & M Univ., College Station (USA)). *Transactions of the American Nuclear Society;* **55**: 292-293(1987). (CONF-8711195—).

From American Nuclear Society winter meeting; Los Angeles, CA, USA (15 Nov 1987).

The purpose of this study was to compare the results of a series of COMETHE III-L calculations carried out on six fuel pins of the ZORITA research and development program with experimental results. The six fuel pins are part of a large number of special Westinghouse test rods from a high power, high burnup research program conducted in the ZORITA reactor facility during cycles 1, 2, and 3. These six fuel rods exhibited unusual behavior in both fission gas released and fuel cladding mechanical interaction. The fuel rods studied achieved average burnups ranging from 34,900 to 55,100 MWd/tonne. The fission gas release values for five of the fuel rods ranged from 7.6 to 19.9% with one rod experiencing cladding failure during cycle 2. The objectives of the study were: (1) to demonstrate the capability of COMETHE III-L to predict extended burnup fuel performance; and (2) to supplement the postulated cause of the fuel rod failures experienced during cycle 2, as developed by Westinghouse. As a consequence, this study will contribute to the date base experience of COMETHE III-L and also present an application of the code capabilities.

2207 Plutonium And Isotope Production Reactors

REFER ALSO TO CITATION(S) 46461, 46644, 46673, 46882, 46884, 46885, 47027

46640 **High-purity isotope production by short-term HFIR irradiations.** Knauer, J.B. Jr.; Alexander, C.W.; Bigelow, J.E.; Wiggins, J.T. (Oak Ridge National Lab., TN (USA)). *Transactions of the American Nuclear Society;* **55**: 239-241(1987). (CONF-8711195—).

From American Nuclear Society winter meeting; Los Angeles, CA, USA (15 Nov 1987).

Techniques and procedures have been developed at the transuranium processing plant to produce quantities of special high-purity isotopes, e.g. ^{227}Ac, ^{242}Cm, ^{250}Cf, ^{251}Cf, and ^{254}Cf by short-term irradiation of appropriate target materials in the high flux isotope reactor (HFIR). The general sequences of operations required to produce special isotopes includes (a) purification of the target isotope from other actinides, lanthanides, and cationic impurities, (b) fabrication of the target assembly; (c) irradiation in HFIR's hydraulic rabbit facility; (d) target dissolution; and (e) product isola-

tion and purification. Usually, all of these steps must be scheduled carefully and coordinated to optimize the yield and enrichment of the product isotope. The operations associated with the various high-purity isotopes are similar and are illustrated by the procedures used to produce ^{249}Cf.

2209 Reactor Safety

REFER ALSO TO CITATION(S) 46436, 46438, 46454, 46527, 46549, 46603, 46607, 46608, 46609, 46610, 46611, 46878, 47306, 47341, 47392, 47395, 48006

46641 (BNL-NUREG—41453) Model development for the determination of the influence of management on plant risk. Haber, S.B.; O'Brien, J.N.; Ryan, T.G. (Brookhaven National Lab., Upton, NY (USA)). 1988. Contract AC02-76CH00016. 5p. (CONF-880633—5). NTIS, PC A02. Order Number DE88013997/JAW.

From 4. international conference on human factors and power plants; Monterey, CA, USA (5 Jun 1988).

This paper outlines the development of an organizational model which will be used to determine the influence of supervisory and management functions in a nuclear power plant (NPP) on risk. A theoretical conceptualization, derived from the empirical literature, is used to describe the organizational structure of NPPs. The parameters and variables associated with this dynamic, process-oriented model are detailed. Applications of the model and preliminary insights derived from this conceptualization are discussed.

46642 (CEGB-TPRD/B—0968/R87) Environmental radioactivity measurements at BNL during the year following the Chernobyl accident. Hancock, R.; Woollam, P.B. (Central Electricity Generating Board, Berkeley (UK). Berkeley Nuclear Labs.). Jul 1987. 21p. NTIS (US Sales Only), PC A03/MF A01. Order Number DE88754271/JAW.

The accident which destroyed Unit 4 of the Chernobyl Nuclear Power Station on 26 April 1986 provided the world's scientists with an opportunity, unique in recent years, to study many of the processes which follow the release of large quantities of radioactivity into the atmosphere. BNL undertook a wide ranging programme of environmental measurements after the accident, the immediate aim being to supply HM Government with data to help assess the radiological consequences to the UK population. As it became clear that the UK dose commitment was relatively low, the thrust of the measurements began to be concentrated on airborne radioactivity and the movement of nuclides in the grass-soil system. The aim of these studies was to assess dispersion and diffusion of radioactivity in these particular compartments of the environment. The measurements have continued over the twelve month period since the Chernobyl accident. This report aims to disseminate the year's data and to offer some initial interpretations of the trends. (U.K.).

46643 (DOE/OR—880) Investigation of the delay in pressure vessel embrittlement specimen analysis for the Oak Ridge National Laboratory High Flux Isotope Reactor. Rothrock, J.D.; Hoffman, E.E.; Manthey, G.C.; Sheffey, D.W. (USDOE Oak Ridge Operations Office, TN). 6 Feb 1987. 248p. NTIS, PC A11. Order Number DE88014068/JAW.

Analysis of the investigative data pertaining to this incident reveals the following conditions as key findings and probable causes: (1) The contractor failed to properly implement the surveillance program for monitoring reactor pressure vessel embrittlement. (2) Contractor and DOE organizations provided less than adequate oversight and independent overview, especially by not requiring operating organizations to provide documented evidence to substantiate claims that there was "no problem" with respect to embrittlement. (3) Although the temperature limitation for reactor pressurization identified in the Technical Specifications was never violated, the basis of this safety limitation was violated. (4) The basis for concluding that there would be no embrittlement of the pressure vessel steel over the expected life of the reactor is questionable. (5) The contractor and DOE failed to make the surveillance program visible by incorporating it in the Technical Specifications. (6) The Accident Analysis/Final Safety Analysis Report was never adequately reviewed and updated subsequent to its initial issuance. (7) Surveillance specimen analysis was incomplete and never transmitted to reactor operating personnel in a usable format prior to November 1986. (8) There was extensive delays (many years) in the testing, analysis, and reporting of surveillance program results.

46644 (DPST—88-617) Guidelines and technical bases for field evaluation of systems important to seismic safety in P reactor. Wingo, H.E. (Savannah River Lab., Aiken, SC (USA)). 12 Jun 1988. Contract AC09-76SR00001. 8p. NTIS, PC A02/MF A01; 1; GPO Dep. Order Number DE88014497/JAW.

A systemic field evaluation of the seismic strength of equipment in P reactor important to safety has been suggested to provide documentation of the current state of seismic strength of P reactor. Once the seismic strength of the reactor is known, an estimate can be made of the current risk of continued operation. The objectives of this field evaluation differ from the more detailed walkdown procedures done as a final resolution of unresolved safety issue A-46. Previous seismic characterization work has been done for SRP reactors to provide general knowledge of the reactor seismic strength. (This general knowledge did not contain sufficient documentation to provide for independent and confirmatory assessment of the seismic risk.) This document provides guidelines to be used for performing field evaluations and the technical bases for these guidelines. 7 refs., 1 fig.

46645 (EPRI-NP—5904) Technical specification improvements to containment heat removal and emergency core cooling systems: Final report. Sullivan, W.P.; Ha, C.; Pentzien, D.C.; Visweswaran, S. (Electric Power Research Inst., Palo Alto, CA (USA); General Electric Co., San Jose, CA (USA). Nuclear Energy Business Operations). Jul 1988. 111p. Unlimited audience, publicly available. Research Reports Center, Box 504090, Palo Alto, CA 94303. Order Number TI88014204/JAW.

This report presents the results of an analysis for technical specification improvements to the emergency core cooling systems (ECCS) and containment heat removal systems (EPRI Research Project 2142-3). The objective of this project is to further develop a reliability- and risk-based methodology to provide improvements by considering groups of surveillance test intervals and allowed out-of-service times jointly. This was done for the technical specifications for the ECCS, containment heat removal equipment, and supporting systems of a boiling water reactor plant. The project (1) developed a methodology for optimizing groups of surveillance test intervals and allowed out-of-service times jointly, (2) applied the methodology in a case study of a specific operating plant, Hatch-2, and (3) evaluated benefits of the application. The results of the case study demonstrate that beneficial technical specification improvements can be realized with application of the methodology. By tightening a small group of sensitive surveillance test intervals (STIs) and allowed out-of-service times (AOTs), a larger group of less sensitive STIs and AOTs can be extended resulting in an overall plant operating cost improvement without reducing the plant safety. The reliability- and risk-based methodology and results from this project can be effectively applied for technical specification improvements at other operating plants.

46646 (GA-A—19317) MHTGR [modular high-temperature gas-cooled reactor] control: A non-safety related system. Rodriguez, C.; Swart, F. (General Atomics Co., San Diego, CA (USA)). Jun 1988. Contract AC03-88SF17367. 5p. NTIS, PC A02/MF A01; 1; GPO Dep. Order Number DE88013682/JAW.

The modular high-temperature gas-cooled reactor (MHTGR) design meets stringent top-level safety regulatory criteria and user requirements that call for high plant availability and no disruption of the public's day to day activities during normal and off-normal operation of the plant. These requirements lead to a plant design that relies mainly on physical properties and passive design features to ensure plant safety regardless of operator actions, plus simplicity and automation to ensure high plant availability and lower cost of operations. The plant does not require safety-related operator actions, and it does not require the control room to be safety related.

46647 (GAO/RCED—87-45) Emergency planning: Federal involvement in preparedness exercise at Shoreham Nuclear Plant. (General Accounting Office, Washington, DC (USA). Resources, Community and Economic Development Div.). 1986. 37p. General Accounting Office, PO Box 6015, Gaithersburg, MD 20877.

GAO reviewed the role of the Federal Emergency Management Agency concerning the off-site emergency response test at the Shoreham nuclear power station in Suffolk County, New York. GAO found that although FEMA has statutorily derived responsibility to review emergency response plans developed by state and local governments, the agency does not have any permanent statutory responsibility to review utility off-site emergency response plans or assess an exercise conducted by a utility. FEMA agreed to review the emergency response plan and monitor the exercise for the Shoreham plant under a memorandum of understanding with the Nuclear Regulatory Commission. FEMA also agreed to review the exercise at Shoreham only after reaching an understanding with NRC that FEMA would not be required to make a finding on off-site preparedness - a decision based on its belief that a FEMA determination could not be made unless state and local governments participated or unless the Long Island Lighting Company, which owns Shoreham, was given the legal authority to fully carry out the plan.

46648 (INIS-mf—11216) Chernobyl its effect on Ireland. Cunningham, J.D.; MacNeill, G.; Pollard, D. (Nuclear Energy Board, Dublin (Ireland)). Mar 1987. 60p. NTIS (US Sales Only), PC A04/MF A01. Order Number DE88702871/JAW.

This report reviews the results of the measurements made during the first six months after the Chernobyl accident to determine the extent of the resultant environmental contamination. Estimates are presented of the individual and collective doses received by the public during the first six months and the first year after the accident.

46649 (KFK—4351) Comparison of the FAUST waster tests to model calculations. Jonas, R.; Schuetz, W. (Kernforschungszentrum Karlsruhe G.m.b.H. (Germany, F.R.). Lab. fuer Aerosolphysik und Filtertechnik 1; Kernforschungszentrum Karlsruhe G.m.b.H. (Germany, F.R.). Projekt Schneller Brueter). Apr 1988. 55p. (In German). NTIS (US Sales Only), PC A04/MF A01. Order Number DE88754602/JAW.

In the experimental KfK-FAUST program, expansion and oscillation of a nitrogen or argon bubble including particle transport and retention after pressure discharge under water or sodium are investigated in a scaled-down reactor geometry. The computer codes PAROGA and BERTA are related to the subject of the FAUST tests. BERTA (bubble expansion in the reactor tank) describes expansion, rise and condensation of a large fuel vapour bubble in a liquid pool. PAROGA (particle deposition in an oscillating gas bubble) calculates one-dimensionally the motion and the deposition of particles which are enclosed in an expanding and rapidly oscillating gas bubble. Calculations with both computer codes are presented. The theoretically determined deposition rates and oscillation periods are compared to the results of the experiments.

46650 (KWU-R—917/86/018) Heat conductance of the fuel-to-cladding gap of LWR rods (irradiation tests). Final report. Boehner, G. (Kraftwerk Union A.G., Erlangen (Germany, F.R.); Bundesministerium fuer Forschung und Technologie, Bonn (Germany, F.R.)). Dec 1986. 159p. (In German). NTIS (US Sales Only), PC A08/MF A01. Order Number DE88754606/JAW.

The fuel temperature - and therefore the stored heat energy which has to be removed in the case of a hypothetical LOCA - strongly depends on the heat conductance of the gap between fuel and cladding. To establish this heat conductance more precisely within existing conservative fuel rod modelling assumptions, irradiation tests with 7 instrumented test fuel rods were performed in the research reactor FRJ-2 of Kernforschungsanlage Juelich (KFA). The (as-fabricated-) gap size, fillgas and fillgas-pressure in the fuel rods as well as the surface roughness of the fuel pellets were varied independently, the influence of these variations was monitored by thermocouples. These in-pile measurements were supplemented by post-irradiation examinations in the Hot Cells of KFA. The test results show no axial gas segregation and with that no temperature changes in the fuel rod during normal reactor operation. No temperature increase caused by different roughness of the fuel pellet surface was observed under these conditions. A data base for further fuel rod modelling development was created by a large amount of measurement data (temperature versus power) under well defined conditions (gas mixtures, gas pressure, condition of the rod quasi - b.o.l.). (orig.) With 4 refs., 5 tabs., 92 figs.

46651 (NUREG—0797-Suppl.15) Safety evaluation report related to the operation of Comanche Peak Steam Electric Station, Units 1 and 2; Docket Nos. 50-445 and 50-446. (Nuclear Regulatory Commission, Washington, DC (USA). Office of Special Projects). Jul 1988. 180p. NTIS, PC A09/MF A01 - GPO. Order Number TI88015388/JAW.

Supplement 15 to the Safety Evaluation Report related to the operation of the Comanche Peak Steam Electric Station (CPSES), Units 1 and 2 (NUREG-0797), has been prepared by the Office of Special Projects of the US Nuclear Regulatory Commission (NRC). The facility is located in Somervell County, Texas, approximately 40 miles southwest of Fort Worth, Texas. This supplement presents the staff's evaluation of the applicant's Corrective Action Program (CAP) related to the design of cable trays and cable tray hangers. The scope and methodologies for the CAP workscope as summarized in Revision O to the cable tray and cable tray hanger project status report and as detailed in related documents referenced in this evaluation were developed to resolve various design issues raised by the Atomic Safety and Licensing Board (ASLB) the intervenor, Citizens Association for Sound Energy (CASE); the Comanche Peak Response Team (CPRT); CYGNA Energy Services (CYGNA); and the NRC staff. The NRC staff concludes that the CAP workscope for cable trays and cable tray hangers provides a comprehensive program for resolving the associated technical concerns identified by the ASLB, CASE, CPRT, CYGNA, and the NRC staff and its implementation ensures that the design of cable trays and cable tray hangers at CPSES satisfies the applicable requirements of 10 CFR Part 50.

46652 (NUREG/CP—0086-Vol.1) Proceedings of the 19th DOE/NRC nuclear air cleaning conference. First, M.W. (ed.). (USDOE Assistant Secretary for Environment, Safety, and Health, Washington, DC; Nuclear Regulatory Commission, Washington, DC (USA); Harvard Univ., Boston, MA (USA). Harvard Air Cleaning Lab.). May 1987. 616p. (CONF-860820—Vol.1). NTIS, PC A99/MF A01 - GPO. Order Number TI88015221/JAW.

From 19. DOE/NRC nuclear air cleaning conference; Seattle, WA, USA (18 Aug 1986).

This document contains the papers and the associated discussions of the 19 DOE/NRC Nuclear Air Cleaning Conference. Sessions were devoted to (1) fire, explosion and accident analysis, (2) adsorption and iodine retention, (3) filters and filter testing, (4) standards and regulation, (5) treatment of radon, krypton, tritium and carbon-14, (6) ventilation and air cleaning in reactor operations, (7) dissolver off-gas cleaning, (8) adsorber fires, (9) nuclear grade carbon testing, (10) sampling and monitoring, and (11) field test experience. Individual papers were processed separately for the data base.

46653 (NUREG/CP—0086-Vol.2) Proceedings of the 19th DOE/NRC nuclear air cleaning conference. First, M.W. (USDOE Assistant Secretary for Environment, Safety, and Health, Washington, DC; Nuclear Regulatory Commission, Washington, DC (USA). Office of Nuclear Reactor Regulation; Harvard Univ., Boston, MA (USA). Harvard Air Cleaning Lab.). May 1987. 678p. (CONF-860820—Vol.2). NTIS, PC A99/MF A01 - GPO. Order Number TI88015222/JAW.

From 19. DOE/NRC nuclear air cleaning conference; Seattle, WA, USA (18 Aug 1986).

This document contains the papers and the associated discussions of the 19 DOE/NRC Nuclear Air Cleaning Conference. Sessions were devoted to (1) fire, explosion and accident analysis, (2) adsorption and iodine retention, (3) filters and filter testing, (4)

standards and regulation, (5) treatment of radon, krypton, tritium and carbon-14, (6) ventilation and air cleaning in reactor operations, (7) dis solver off-gas cleaning, (8) adsorber fires, (9) nuclear grade carbon testing, (10) sampling and monitoring, and (11) field test experience. Individual papers were processed separately for the data bases.

46654 **(NUREG/CR—5157) The development of APRIL.MOD2: A computer code for core meltdown accident analysis of boiling water nuclear reactors.** Kim, S.H.; Kim, D.H.; Koh, B.R.; Pessanha, J.; SiAhmed, E.K.; Podowski, M.Z.; Lahey, R.T. Jr. (Oak Ridge National Lab., TN (USA); Rensselaer Polytechnic Inst., Troy, NY (USA)). Jul 1988. Contract AC05-84OR21400. 279p. (ORNL/Sub—81-9089/3). NTIS, PC A13/MF A01 - GPO. Order Number TI88012914/JAW.

This report summarizes the thermal-hydraulic models used in APRIL. MOD2. This digital computer code was developed at Rensselaer Polytechnic Institute Corporation (ESEERCO) and the Boiling Water Reactor Severe Accident Technology Program at Oak Ridge National Laboratory (ORNL). The APRIL.MOD2 code can be used for the mechanistic analysis of severe accident phenomena in Boiling Water Nuclear Reactors (BWRs) having either Mark-I or Mark-II containment systems.

46655 **(ORNL—6466) The potential use of Chernobyl fallout data to test and evaluate the predictions of environmental radiological assessment models.** Richmond, C.R.; Hoffman, F.O.; Blaylock, B.G.; Eckerman, K.F.; Lesslie, P.A.; Miller, C.W.; Ng, Y.C.; Till, J.E. (Oak Ridge National Lab., TN (USA)). Jun 1988. Contract AC05-84OR21400. 189p. NTIS, PC A09. Order Number DE88013335/JAW.

The objectives of the Model Validation Committee were to collaborate with US and foreign scientists to collect, manage, and evaluate data for identifying critical research issues and data needs to support an integrated assessment of the Chernobyl nuclear accident; test environmental transport, human dosimetric, and health effects models against measured data to determine their efficacy in guiding decisions on protective actions and in estimating exposures to populations and individuals following a nuclear accident; and apply Chernobyl data to quantifications of key processes governing the environmental transport, fate and effects of radionuclides and other trace substances. 55 refs.

46656 **(PNL-SA—13737) A cost/risk analysis of evacuation options.** Tawil, J.J.; Strenge, D.L. (Pacific Northwest Lab., Richland, WA (USA)). Feb 1986. Contract AC06-76RL01830. 39p. NTIS, PC A03/MF A01; 1; GPO Dep. Order Number DE88013185/JAW.

In this paper we evaluate the costs and risks associated with evacuating an area threatened by a nuclear power plant accident. The risks refer to the expected health effects from radiation dose that would be received by individuals if they did not evacuate, while the costs refer to the evacuation costs. For a given dispersion of radionuclides, the evacuation costs will vary primarily with 1) the exposure risk level, which determines the outer boundaries of the evacuation zone, and 2) the shape of the evacuation zone. Results are produced for a range of exposure risk levels and for two evacuation zone configurations. One configuration minimizes the number of evacuees for a given exposure risk level; the second is easier to implement.

46657 **(RISO-M—2692-App.1) Final report of the Risoe monitoring programme after the Chernobyl accident for the period October 1, 1986-September 30, 1987. Appendix 1. Descriptions of monitoring programme.** Aarkrog, A.; Nielsen, S.P.; Dahlgaard, H.; Lauridsen, B.; Sxgaard-Hansen, J. (Risoe National Lab., Roskilde (Denmark)). Jan 1988. 20p. (In Danish). NTIS (US Sales Only), PC A03/MF A01. Order Number DE88753658/JAW.

This appendix contains the Risoe monitoring programme after the Chernobyl accident, for the period October 1, 1986-September 30, 1987.

46658 **(SKB-TR—87-27) Earthquake measurements in southern Sweden October 1, 1986-March 31, 1987.** Slunga, R.; Nordgren, L. (Foersvarets Forskningsanstalt, Stockholm (Sweden)). (Swedish Nuclear Fuel and Waste Management Co., Stockholm; Foersvarets Forskningsanstalt, Stockholm (Sweden)). Dec 1987. 58p. NTIS (US Sales Only), PC A04/MF A01. Order Number DE88754371/JAW.

A network of four stations covering southeastern Sweden has been operated for the period Oct 1, 1986 - Mar 31, 1987. Three events were aftershocks to the strong Skoevde event, 860714, ML=4.5. This made it necessary to include the Skoevde main event together with a couple of earlier aftershocks in the analysis presented in this report. Thus the present study gives 10 new earthquake mechanisms. Three of these events are in the range ML=3.5-4.5. Of the earlier about 170 earthquake mechanisms available for southern Sweden the largest is ML=3.2. The earthquakes of the present study thus give significant new information about Swedish seismic activity.

46659 **(SRD-R—428) Guide on fire precautions.** Burke, G.; Finucane, M. (UKAEA Safety and Reliability Directorate, Culcheth). Dec 1987. 31p. H.M. Stationery Office, London, price Pound 5.00.

The report sets down principles of fire precautions in the four areas of: life protection, fire protection, fire prevention, and system performance. Each fire precaution theme is considered in detail, and the logic behind the principles and ways of applying them in practice is discussed. There is no attempt to cover in depth each area, but should still be of use to designers, operators and safety assessors.

46660 **High-efficiency scintillation detector for thermal and high-energy neutrons and gamma radiation.** Chiles, M.M.; Mihalczo, J.T.; Blakeman, E.D. (Oak Ridge National Lab., Oak Ridge, TN (US)). *IEEE (Institute of Electrical and Electronics Engineers) Transactions on Nuclear Science;* **35**: No. 1, 110-113(Feb 1988). (CONF-871006—).

From 34. nuclear science symposium and 19. nuclear power systems symposium; San Francisco, CA, USA (21 Oct 1987).

Subcriticality experiments require high-efficiency radiation detectors that are sensitive to neutrons (thermal and fast) over a wide energy range and to gamma radiation. The need for such detectors arises from various requirements including physical limitations, cost effectiveness, and simplicity. The objective of this development project was to provide a single detector that meets these requirements to replace the separate detectors previously needed to detect the different radiation emissions. This report describes a new scintillation detector design, which consists of two scintillators assembled on a single photomultiplier tube. One scintillator is glass loaded with lithium enriched in /sup 6/Li and has high efficiency for low energy neutrons. The second scintillator is a plastic having very good efficiency for higher energy neutrons. Efficiency values are reported for various neutron energy ranges and for gamma radiation.

46661 **Automated long-term surveillance of a commercial nuclear power plant.** Smith, C.M.; Gonzalez, R.C. (Oak Ridge National Lab., P.O. Box X, Oak Ridge, TN (US)). *IEEE (Institute of Electrical and Electronics Engineers) Transactions on Nuclear Science;* **35**: No. 1, 966-980(Feb 1988).

This paper describes a pattern recognition system for monitoring nuclear reactor signals. The system is based on detecting deviations from baseline signatures identified during normal plant operation. The capabilities and limitations of this pattern recognition approach were investigated during a 2-1/2-year series of continuous online experiments at the Sequoyah-1 Nuclear Power Plant.

46662 **Light water reactor (LWR) innovation needs in the United States: The Massachusetts Institute of Technology LWR innovation project.** Golay, M.W. (Massachusetts Institute of Technology, Dept. of Nuclear Engineering, Cambridge, MA (US)). *Nuclear Technology;* **80**: No. 1, 42-60(Jan 1988).

A major effort under way within the Massachusetts Institute of Technology (MIT) Engineering School is focused on the contributions that technology innovation can make in revitalizing nuclear power in the United States. A principal component of this effort is a project to improve the designs of the next generation of light water reactors (LWRs) with emphasis on achieving improved capacity factors and safety, and reducing the construction duration. The motivation for this overall effort is to prevent the nuclear option from being unnecessarily lost by being available only in uneconomic configurations. In considering how to advance this effort, the authors focused on refining the designs of new reactors because this is the area where the greatest opportunities for improvements exist.

46663 **Inherent safety of the thermionic space reactors.** Stamatelatos, M.G.; Barsell, A.W.; Fisher, C.R. (GA Technologies Inc., San Diego, CA (USA)). pp 51-65 of Space nuclear power systems, 1986: Volume 5. El-Genk, M.S.; Hoover, M.D. (eds.). Malabar, FL; ORBIT Book Company, Inc. (1987). (CONF-860102—).

From 3. symposium on space nuclear power systems; Albuquerque, NM, USA (13 Jan 1986).

The safety performance of the GA SP-100 in-core thermionic space nuclear reactor was evaluated throughout its mission phases from prelaunch to end-of-life disposal. The main issues addressed here are safety design features, the potential for accidental criticality, overheating and undercooling accidents during operation. Launch pad accidents, and health hazards related to those accidents. Criticality was analyzed for compaction (with and without outer reflector), water immersion, and fire conditions. Due to the negative reactivity of the in-core refractory metals, subcriticality margins were sufficient to encompass uncertainties. The inherent safety of the design was demonstrated for mission operation accidents of loss of coolant main circulation pump and sudden loss of coolant. The thermal and mechanical environments of a launch pad abort fireball were analyzed with respect to survivability of the radioactive fuel and toxic chemical material, particularly beryllium. While survival of the tungsten emitter around the fuel is predicted, neither radioactive nor toxic chemical hazards would exceed safety standards beyond the site even if all such material were released.

46664 **Reentry safety of the thermionic space reactor.** Barsell, A.W.; Hwa, V.; Stamatelatos, M.G. (GA Technologies Inc., San Diego, CA (USA)). pp 67-78 of Space nuclear power systems, 1986: Volume 5. El-Genk, M.S.; Hoover, M.D. (eds.). Malabar, FL; ORBIT Book Company, Inc. (1987). (CONF-860102—).

From 3. symposium on space nuclear power systems; Albuquerque, NM, USA (13 Jan 1986).

A reentry trajectory, heating, and ablation analysis has been performed for the thermionic SP-100 reactor design during Earth orbital decay and severe steep angle reentries. The reactor assembly, including reactor, reflector drums and radiator, was predicted to survive the heating and oxidation environments of reentry without breakup or ablation. Even for separate reentry of the reactor components, no significant ablation of fuel or toxic materials was calculated. Upon ground impact, the reactor was predicted to become buried and inaccessible. The high temperature and high strength capability of the materials in the thermionic reactor design lead to an essentially intact reentry. Nevertheless, the hazards associated with dispersion of the radioactive fuel and toxic materials in the atmosphere or after impact were assessed and shown to comply with safety criteria. This conclusion holds even for reentry soon after reactor operation in space.

46665 **Sand86-2189C; Reverse Hopkinson Bar Testing.** Bell, W.K.; Davie, N.T. (Div. 7541, Sandia National Labs., Albuquerque, NM (US)). pp 26-30 of Proceedings of the 33rd annual technical meeting of the Institute of Environmental Sciences on environmental technology: Knowing the way. Mt. Prospect, IL; Institute of Environmental Sciences (1987). (CONF-870566—).

From Institute of Environmental Sciences annual meeting; San Jose, CA, USA (4 May 1987).

A new test technique, Reverse Hopkinson Bar Testing, has been developed for mechanical shock simulation. A long cylindrical aluminum bar is used as a projectile to strike a test item. The strain wave in the bar is measured and from this, the input force to the test item can be calculated. This method generates a trapezoid shaped force-time history at the bar, test item interface. The test technique is described in detail, and it will be shown how the peak force and force pulse duration can be independently controlled. Reverse Hopkinson Bar testing of a Nuclear Depth Bomb is described where the technique is used to simulate the water impact force the weapon experiences upon striking the ocean surface. Results of the simulation are compared with field test data.

46666 **Touch screen man machine interfere for emergency dose calculations.** Woodard, K.; Abrams, M. *Transactions of the American Nuclear Society;* **55**: 95-96(1987). (CONF-8711195—).

From American Nuclear Society winter meeting; Los Angeles, CA, USA (15 Nov 1987).

Emergency dose calculation systems generally use a keyboard to provide the interface between the user and the computer. This interface is preferred by users who work daily with computers; however, for many plant personnel who are not continuously involved with computer operations, the use of a keyboard can be cumbersome and time consuming. This is particularly true when the user is under pressure during a drill or an actual emergency. Experience in many applications of Pickard, Lowe and Garrick's PLG's Meteorological Information and Dose Assessment System (MIDAS) has shown that user friendliness is a key ingredient toward achieving acceptance of computerized systems. Hardware to support to touch screen interface is now available and has been implemented in MIDAS. Recent experience has demonstrated that selection times for dose calculations are reduced, data entry errors have been minimized, and confusion over appropriate entries has been avoided due to the built-in logic. A 10-yr search for an acceptable keyboard replacement has ended.

46667 **IEEE guide for the application of human factors engineering.** Zgliczynski, J.B. *Transactions of the American Nuclear Society;* **55**: 155-156(1987). (CONF-8711195—).

From American Nuclear Society winter meeting; Los Angeles, CA, USA (15 Nov 1987).

This presentation discusses the need for an industry standard for applying human factors engineering (HFE) to nuclear power plants, the development of a draft Institute of Electrical and Electronics Engineers (IEEE) standard project, a summary of the content of the draft standard, and its status in the consensus process.

46668 **IEEE guide for the analysis of human reliability.** Dougherty, E.M. Jr. (SAIC, Oak Ridge, TN (USA)). *Transactions of the American Nuclear Society;* **55**: 156-157(1987). (CONF-8711195—).

From American Nuclear Society winter meeting; Los Angeles, CA, USA (15 Nov 1987).

The Institute of Electrical and Electronics Engineers (IEEE) working group 7.4 of the Human Factors and Control Facilities Subcommittee of the Nuclear Power Engineering Committee (NPEC) has released its fifth draft of a Guide for General Principles of Human Action Reliability Analysis for Nuclear Power Generating Stations, for approval of NPEC. A guide is the least mandating in the IEEE hierarchy of standards. The purpose is to enhance the performance of an human reliability analysis (HRA) as a part of a probabilistic risk assessment (PRA), to assure reproducible results, and to standardize documentation. The guide does not recommend or even discuss specific techniques, which are too rapidly evolving today. Considerable maturation in the analysis of human reliability in a PRA context has taken place in recent years. The IEEE guide on this subject is an initial step toward bringing HRA out of the research and development arena into the toolbox of standard engineering practices.

46669 **IEEE 845 - a proposed guideline for use of human factors in design and retrofit design of nuclear power plants.** Schurman, D.L. *Transactions of the American Nuclear Society;* **55**: 157(1987). (CONF-8711195—).

From American Nuclear Society winter meeting; Los Angeles, CA, USA (15 Nov 1987).

This paper describes the development and content of the Institute of Electrical and Electronics Engineers (IEEE) Standard

845. This guide was developed by Working Group 7.2 of Subcommittee 7 of the Nuclear Power Engineering Committee of the Power Engineering Society of the IEEE. The guide has been approved by the Nuclear Power Engineering Committee (NPEC) and is now in the standards development and approval process. The guide is the first standards action approved by the NPEC of IEEE and is presented here to obtain wider peer response to its content. The guide provides a systematic framework for selection of human factors techniques and for the use of those techniques. The guide also provides a list of commonly used human factors techniques, along with a commentary about cost, ease of use, and other characteristics of each of the techniques. The guide is written with the project engineer and design engineer in mind. Thus, the guide attempts to provide a basis for the systematic selection of human factors techniques for various purposes and guidance regarding which of these techniques is likely to require the assistance of a human factors expert to apply.

46670 **Sensitivity analysis technique for application to deterministic models.** Ishigami, T.; Cazzoli, E.; Khatib-Rahbar, M.; Unwin, S.D. (Brookhaven National Lab., Upton, NY (USA)). *Transactions of the American Nuclear Society;* **55**: 313-314(1987). (CONF-8711195—).

From American Nuclear Society winter meeting; Los Angeles, CA, USA (15 Nov 1987).

The characterization of sever accident source terms for light water reactors should include consideration of uncertainties. An important element of any uncertainty analysis is an evaluation of the sensitivity of the output probability distributions reflecting source term uncertainties to assumptions regarding the input probability distributions. Historically, response surface methods (RSMs) were developed to replace physical models using, for example, regression techniques, with simplified models for example, regression techniques, with simplified models for extensive calculations. The purpose of this paper is to present a new method for sensitivity analysis that does not utilize RSM, but instead relies directly on the results obtained from the original computer code calculations. The merits of this approach are demonstrated by application of the proposed method to the suppression pool aerosol removal code (SPARC), and the results are compared with those obtained by sensitivity analysis with (a) the code itself, (b) a regression model, and (c) Iman's method.

46671 **Parallel algorithms for continuum dynamics.** Hicks, D.L.; Liebrock, L.M. (Michigan Technological Univ., Houghton (USA)). *Transactions of the American Nuclear Society;* **55**: 330-331(1987). (CONF-8711195—).

From American Nuclear Society winter meeting; Los Angeles, CA, USA (15 Nov 1987).

Simply porting existing parallel programs to a new parallel processor may not achieve the full speedup possible; to achieve the maximum efficiency may require redesigning the parallel algorithms for the specific architecture. The authors discuss here parallel algorithms that were developed first for the HEP processor and then ported to the CRAY X-MP/4, the ELXSI/10, and the Intel iPSC/32. Focus is mainly on the most recent parallel processing results produced, i.e., those on the Intel Hypercube. The applications are simulations of continuum dynamics in which the momentum and stress gradients are important. Examples of these are inertial confinement fusion experiments, severe breaks in the coolant system of a reactor, weapons physics, shock-wave physics. Speedup efficiencies on the Intel iPSC Hypercube are very sensitive to the ratio of communication to computation. Great care must be taken in designing algorithms for this machine to avoid global communication. This is much more critical on the iPSC than it was on the three previous parallel processors.

46672 **Current limitations of trend curve analysis for the prediction of reactor PV embrittlement.** Gold, R.; McElroy, W.N. (Westinghouse Hanford Co., Hanford Engineering Development Lab., Richland, WA (US)). pp 552-568 of Influence of radiation on material properties: ASTM 13th international symposium (Part II). Garner, F.A.; Henager, C.H.; Igata, N. Philadelphia, PA; ASTM (1987). (CONF-860605—).

From 13. international symposium on the effects of radiation on materials; Seattle, WA, USA (23 Jun 1986).

To define the effects of neutron radiation damage on LWR pressure-temperature operating limits and to assess fracture toughness of power reactor PV, trend curves for the prediction of PV embrittlement have been developed. These trend curves are very general PV embrittlement curves that are used to evaluate current PV status as well as to predict the future state of the PV. In such trend curves, the two main measures of radiation damage are the adjusted reference nil-ductility temperature ART/sub NDT/(RT/sub NDT/initial + ΔRT/sub NDT/) and the decrease in upper-shelf energy level determined from Charpy V notch impact tests. Current measures of neutron exposure most commonly used in trend curve analyses are fluence > 1 MeV and displacements per atom (dpa) in iron. Since trend curves play such a crucial role in the assessment of PV embrittlement of operating commercial LWR power plants, a critical appraisal of trend curve analysis is essential. To this end, current limitations in trend curve analysis for the prediction of reactor PV embrittlement are examined. It is concluded that a number of systematic effects can arise because environmental differences exist between test reactors, surveillance capsule locations, and the actual irradiation conditions that accrue within the PV of an operating LWR commercial power plant. An irradiation test program is advanced to investigate these systematic effects and to produce the requisite data needed to correct for such systematic biases in trend curve analysis.

46673 **Northrop TRIGA facility decommissioning plan versus actual results.** Gardner, F.W. *Transactions of the American Nuclear Society;* **52**: 36(1986). (CONF-860610—Summs.).

From American Nuclear Society annual meeting; Reno, NV, USA (15 Jun 1986).

This paper compares the TRIGA facility decontamination and decommissioning (D & D) plan to the actual results and discusses key areas where operational activities were impacted by the final US Nuclear Regulatory Commission approved D & D plan. A discussion of fuel transport, release criteria, and release survey plans is included.

46674 **Present supply of graduate-level health physicists in the United States.** Williamson, R.C. (Oak Ridge Associated Universities, TN (USA)). *Transactions of the American Nuclear Society;* **52**: 103-104(1986). (CONF-860610—Summs.).

From American Nuclear Society annual meeting; Reno, NV, USA (15 Jun 1986).

This paper provides information on the number of graduate degrees granted in health physics over the past decade. It identifies factors that characterize this important occupational group and gives related information on the US Dept. of Energy (DOE) Health Physics Fellowship program.

25 ENERGY STORAGE

2506 Thermal

46675 **(NEI-DK—84) Finite element method for heat and mass transport in porous structures; Users Manual for program D2AQ.** Olsen, H.; Reffstrup, J.; Niemi Soerensen, S. (Danmarks Tekniske Hojskole, Lyngby. Lab. for Energiteknik; Danmarks Geologiske Undersoegelske, Copenhagen; Risoe National Lab., Roskilde (Denmark)). Dec 1981. 257p. NTIS (US Sales Only), PC A12. Order Number DE88754082/JAW.

The program is designed to calculate the dimensionless pressure and temperature distributions as a function of time during fluid injection into (or withdrawal from) a porous media. In the examples considered the fluid will be water and the porous media is soil. The numerical model is three-dimensional, assuming axis-symmetry in a cylindrical coordinate system. As an option calculations can be carried out in Cartesian coordinates, if the physical conditions are constant in one direction. Due to these assumptions actual numerical modelling only deals with two-dimensional solution domains. Pressure and temperature distributions are found through a Galerkin Finite Element formulation of continuity- and energy-equations.

Time development of the temperature field is simulated by a simple Finite Difference Method.

46676 (ORNL/TM—10380) Hypereutectic heat storage alloy: Final report, Silicon shell integrity in molten Al-Si eutectic. Bennett, M.R.; Braunstein, J. (Oak Ridge National Lab., TN (USA)). Jun 1988. Contract AC05-84OR21400. 39p. NTIS, PC A03/MF A01; 1; GPO Dep. Order Number DE88013352/JAW.

As a part of a program to evaluate the feasibility of using silicon encapsulated spheres of aluminum--silicon eutectic for thermal energy storage at temperatures near 650{degree}C, experiments were done to test the dimensional stability of the interface between silicon and the eutectic to thermal cycling. Cycled samples were sectioned and examined by optical micrography and by electron microscopy (SEM/EDX) techniques. Little or no degradation of the interface was observed at 600{degree}C (eutectic temperature 577{degree}C) while catastrophic degradation occurred at 700{degree}C. AT 650{degree}C interpenetration of 0.1{endash}0.2 mm was observed between the silicon and the eutectic alloys, with occasional larger (3{endash}4 mm) intrusions. 11 refs., 15 figs., 3 tabs.

2509 Batteries

REFER ALSO TO CITATION(S) 47053, 47053

46677 (EPRI-AP/EM—5895) Load-leveling lead-acid battery systems for customer-side applications: Market potential and commercialization strategy: Final report. Duchi, M.L.; Garimella, S.; Hurwitch, J.W. (Electric Power Research Inst., Palo Alto, CA (USA); Battelle Columbus Div., OH (USA)). Jul 1988. 138p. Research Reports Center, Box 50490, Palo Alto, CA 94303. Order Number TI88013252/JAW.

This report describes work conducted in EPRI research project RP1084-21 titled "Load Leveling Lead Acid Battery Systems for Customer Side Applications: Market Potential and Commercialization Strategy". The purpose of this study was two-fold: To estimate the probable market potential of customer-side-of-the-electric-meter (CSOM) applications of load leveling lead-acid battery systems; to develop a commercialization strategy for these battery systems consistent with the estimated market potential. The study was designed to provide utilities and other interested groups with market-side information to help them determine the desirability of incorporating CSOM into their future plans. 8 refs., 25 figs., 17 tabs.

29 ENERGY PLANNING AND POLICY

46678 (INIS-mf—11791) Energy supply system of the Land Schleswig-Holstein now and in future. Government policy statement by the Prime Minister of the Land Schleswig-Holstein, Dr. Uwe Barschel, of June 18, 1986. Barschel, U. (Landesregierung Schleswig-Holstein, Kiel (Germany, F.R.). Presse- und Informationsstelle). 1986. 29p. (In German). NTIS (US Sales Only), PC A03/MF A01. Order Number DE88754598/JAW.

The leaflet presents a governmental declaration dealing with the energy supply situation in Schleswig-Holstein and with the Land's energy policy.

2901 Energy Analysis And Modeling

REFER ALSO TO CITATION(S) 46687, 46722

46679 (NEI-DK—82) Regional energy planning in the County of Soenderjylland. (Cowiconsult Raadgivende Ingenioerer A/S, Virum (Denmark); Institut for Graenseregionsforskning, Aabenraa (Denmark); Soenderjyllands Amtskommune, Aabenraa (Denmark). Plan- og Fredningsvaesenet). Sep 1987. 300p. NTIS (US Sales Only), PC A13/MF A01. Order Number DE88754080/JAW.

The objective of this project is to study what possibilities exist for planning the total energy supply structure on a regional basis. The pilot area selected is the County of Soenderjylland. We have emphasized coordination of energy supply for heating, electricity, industrial processes and transport, taking national and regional objectives for environemntal quality, regional development and the use of local sources of energy into account. The project has been carried out by the County Council of Soenderjylland with the "Institut for Graenseregionsforskning" (The Institute for Regional Research) and Cowiconsult as consultants. During the course of the work valuable assistance has been received from Soenderjyllands Hoejspaendingsvaerk (the electricity generation company of Soenderjylland), the electricity distribution companies and the Danish Energy Agency. Financial support has been granted from EEC, the Ministry of Energy and the Danish Energy Agency.

46680 (RISO-R—553) Systems Analysis Department. Annual progress report 1987. Fuller, E.C.; Larsen, H.; Mackenzie, G.A. (eds.). (Risoe National Lab., Roskilde (Denmark)). Mar 1988. 31p. NTIS (US Sales Only), PC A03/MF A01. Order Number DE88754087/JAW.

The report describes the work of the Systems Analysis Department at Risoe National Laboratory during 1987. The activities may be classified as energy systems analysis and risk and reliability analysis. The report includes a list of staff members. 21 refs.

2902 Economics And Sociology

REFER ALSO TO CITATION(S) 46501, 46677, 46699, 46701, 46708, 46722, 46729, 46740, 46751

46681 (DOE/CE/64606—T1-Vol.1) Institutional energy efficiency partnership program: Final report. (Pennsylvania Energy Office, Harrisburg (USA)). 30 Jun 1988. Contract FG01-86CE64606. 8p. NTIS, PC A03/MF A01; 1; GPO Dep. Order Number DE88012467/JAW.

Recognizing the potential benefits to Pennsylvania schools, the Pennsylvania Energy Office (PEO) designed a program to encourage energy efficiency and make greater use of non-federal dollars to achieve that efficiency. The PEO received a $154,018 grant from the US Department of Energy (DOE), and contracted with Hansen Associates, Inc., to implement the Institutional Energy Efficiency Partnership Project. Project implementation began in February, 1987 and concluded in November, 1987. The project purpose was to enhance school people's knowledge of energy efficiency and alternative financing opportunities through a demonstration program. A broad goal of the program was to expand institutional reliance on non-federal organization and private sector resources for technical assistance and enemy conservation investment. The program was designed to create a series of partnerships and supportive relationships among fifteen school district demonstration sites, the PEO, and technical and financial resources available to Pennsylvania schools. This is Volume 1 of the final status report on this program.

46682 (DOE/CE/64606—T1-Vol.2) Institutional energy efficiency partnership program: Final report. (USDOE, Washington, DC; Pennsylvania Energy Office, Harrisburg (USA); Hansen Associates, Inc., Annapolis, MD (USA)). [30 Jun 1988]. Contract FG01-86CE64606. 169p. NTIS, PC A08/MF A01; 1; GPO Dep. Order Number DE88012343/JAW.

Recognizing the potential benefits to Pennsylvania schools, the Pennsylvania Energy Office (PEO) designed a program to encourage energy efficiency and make greater use of non-federal dollars to achieve that efficiency. The PEO received a $154,018 grant from the US Department of Energy, and contracted with Hansen Associates, Inc. to implement the Institutional Energy Efficiency Partnership Project. Project implementation began in February 1987 and concluded in November 1987. The project purpose was to enhance school people's knowledge of energy efficiency and alternative financing opportunities through a demonstration program. A broad goal of the program was to expand institutional reliance on non-federal organizations and private sector resources for technical assistance and energy conservation investment. The program was

designed to create a series of partnerships and supportive relationships among fifteen school district demonstration sites, the PEO, and technical and financial resources available to Pennsylvania schools. This is volume 2 of the final status report on this program.

46683 **(DOE/MI/10026—T1) Fort Valley State College Cooperative Developmental Energy Program: Final performance report.** (Fort Valley State Coll., GA (USA)). 27 Jun 1988. Contract FC01-83MI10026. 13p. NTIS, PC A03/MF A01; 1; GPO Dep. Order Number DE88013517/JAW.

On July 1, 1983, Fort Valley State College received seed money from the Office of Minority Economic Impact of the US Department of Energy to implement an innovative Energy Education Program that would increase the number of minorities and women working in the private and governmental sectors of the energy industry. The innovative program at Fort Valley State College is called the Cooperative Developmental Energy Program (CDEP). The objective of CDEP is to develop a mutually beneficial long-term synergistic relationship between Fort Valley State College and the private and governmental sectors of the nation's energy industry in creating a technology-oriented labor base for minorities; this objective is accomplished by the development of energy-based curricula, student summer internships and student Co-op programs. 1 fig.

46684 **(GAO/OGC—88-2) Impoundments: Comments on proposed deferrals of FY 1988 Energy and Justice Department funds.** (Office of the Comptroller General, Washington, DC (USA)). 1987. 4p. US General Accounting Office, P.O. Box 6015, Gaithersburg, MD 20877.

The President's second special message for FY 1988 reports new deferrals for the Departments of Energy and Justice in the amounts of $774,000 and $85,000,000 respectively.

2903 Environment, Health, And Safety

REFER ALSO TO CITATION(S) 46258, 46362, 46373, 46379, 46647, 46700, 46721, 46723, 46751, 47294, 47326, 47327, 47349

46685 **(LBL—24347) The indoor environment of commercial buildings: A review: Final report.** Grimsrud, D.T.; Brown, J.T.; Fisk, W.J.; Girman, J.R. (Lawrence Berkeley Lab., CA (USA)). Aug 1987. Contract AC03-76SF00098. 130p. NTIS, PC A07/MF A01; 1; GPO Dep. Order Number DE88014033/JAW.

This report reviews current information that has been gathered recently about the indoor environment in commercial buildings. Basic background information about air pollutants, their concentrations and control presented. Special attention is given to a discussion of ventilation systems since these systems provide the basic pollutant control function for the building. The contribution of pollutants, malfunctioning ventilation and other causes to building complaints is a recurring theme of the treatment. 203 refs., 10 tabs.

2904 Natural Resources

REFER ALSO TO CITATION(S) 47220

2905 Research, Development, Demonstration, And Commercialization

REFER ALSO TO CITATION(S) 46399, 46520, 46708, 46763

2906 Nuclear Energy

REFER ALSO TO CITATION(S) 46325, 46327, 46373, 46606, 46647

2908 Waste Heat Utilization

REFER ALSO TO CITATION(S) 46752

2910 Conservation

REFER ALSO TO CITATION(S) 46708, 46724

46686 **(DOE/CE—0206) DOE state and local assistance programs, 1987 report: Program activities.** (USDOE Assistant Secretary for Conservation and Renewable Energy, Washington, DC). Dec 1987. 22p. NTIS, PC A03/MF A01; 1; GPO Dep. Order Number DE88014198/JAW.

Despite the recent rise in energy consumption, the nation's demand for energy remains below levels of the 1970's. This has been due in part to the cooperative energy efficiency activities of Federal, State and local governments and, increasingly, the private sector. Our mutual goal of expanding the efficient use of energy has remained constant over the years although our respective roles have changed as the non-Federal sector has acquired the skills and resources to plan and carry out energy conservation programs. During 1987 key activities of the Office of State and Local Assistance Programs (OSLAP) focused on increasing non-Federal participation in energy projects as well as on maintaining oversight of grant-funded and oil overcharge programs: OSLAP provided training, technical and oversight assistance to support the States in carrying out grant programs; Monitored State plans for, and expenditure of, petroleum overcharge funds to ensure that Exxon and Stripper Well funds would be used consistent with the overcharge legislation and Court settlements; Encouraged and facilitated private sector energy efficiency initiatives; Distributed information on advanced conservation technologies, and promoted information sharing among the States, local governments and private organizations; Established a reliable data base on State programs and expenditures for both appropriated and oil overcharge funds.

2920 Supply, Demand, And Forecasting

REFER ALSO TO CITATION(S) 46279, 46314, 46699

46687 **(AFME—83-0219) Energy socio-economy.** Chateau, B.; Lapillonne, B.; Bourgeois, B.; Bonaiti, J.P.; Ramain, P. (Agence Francaise pour la Maitrise de l'Energie, 75 - Paris). 1985. 73p. (In French). NTIS (US Sales Only), PC A04/MF A01. Order Number DE88754209/JAW.

The energy demand at a regional level (in France) is analysed and modelized. The models are then used as tools to evaluate the effects of new energy supply conditions in the region, to establish and compare various energy strategies. The implication of the local actors and organizations in the energy conservation/production schemes are observed and their influence on the global strategy and local politics are described.

46688 **(LBL—24198) Transportation in the LDCs: A major area of growth in world oil demand.** Meyers, S. (Lawrence Berkeley Lab., CA (USA)). Mar 1988. Contract AC03-76SF00098. 34p. NTIS, PC A03/MF A01; 1; GPO Dep. Order Number DE88014057/JAW.

This document contains five essays on the effect of activities in lesser developed countries on the demand for oil. The first report targets transportation as the biggest area of growth in oil use. A second discussion evaluates the increases in vehicle numbers as a

driving force in the increased demand. A third study notes changes in the types of vehicles purchased as oil demand modifies prices. A less significant but rapidly growing area of oil use is in air travel as countries attempt to increase contacts with the West. The last report compares the relative growth in demand among countries in this economic group. 35 refs., 10 figs., 4 tabs. (TEM)

2930 Policy, Legislation, And Regulation

REFER ALSO TO CITATION(S) 46258, 46315, 46362, 46513, 46652, 46653, 46681, 46682, 46684, 46686

46689 (NEI-DK—81) Energy planning 1987. Status report. (Energiministeriet, Copenhagen (Denmark)). Dec 1987. 71p. (In Danish). NTIS (US Sales Only), PC A04/MF A01. Order Number DE88754079/JAW.

The status report contains a survey of present and expected energy consumption and supply in Denmark, this is connected with the development of internal production of energy. Future policy and planning is presented for three areas - heat supply planning, electricity planning and conservation and exploration and exploitation of oil and gas. (SM).

46690 (NEI-DK—91) Alternative energy plans for Denmark. On national and regional level. Meyer, N.I.; Noergaard, J.S. (Danmarks Tekniske Hoejskole, Lyngby. Fysisk Lab. 3). Feb 1987. 20p. NTIS (US Sales Only), PC A03/MF A01. Order Number DE88754084/JAW.

This paper describes an alternative energy plan for Denmark and compares it with the latest official plan proposed by the Danish Government. In the alternative plan it is assumed that demand for material goods will tend to saturate within 15 to 20 years. This is based on surveys of people's preference in Denmark to-day. Technical possibilities for energy savings and their costs are investigated. The alternative plan could within 20 years lead to a consumption of primary energy of less than half the amount resulting from the offical plan, and at a lower total cost. Furthermore, the consumption would by then be declining in the alternative plan, contrary to the growing demand in the government's plan. The supply system in the alternative energy plan is based to a high degree on local, renewable energy sources. This will imply a radical change of the present supply system in Denmark. In order to demonstrate the feasibility of the alternative supply system a regional project is being implemented on the island of Bornholm. This project is described in the paper. 17 refs.

2940 Fossil Fuels

REFER ALSO TO CITATION(S) 46223, 46258, 46279, 46280, 46300, 46308, 46309, 46310, 46314, 46315, 46688

46691 (CONF-880773—Pt.1) US fossil fuel technologies for developing countries: Costa Rica country packet. (Argonne National Lab., IL (USA); USDOE Assistant Secretary for Fossil Energy, Washington, DC). 21 Jul 1988. Contract W-31109-ENG-38. 48p. NTIS, PC A04/MF A01; 1; GPO Dep. Order Number DE88013528/JAW.

From U.S. fossil fuel technologies for developing countries; Washington, DC, USA (21 Jul 1988).

Costa Rica presents long-term opportunities for US participation in the power generation sector. A growing industrial base, high economic growth, and an increasing living standard will continue to require more reliable electric generation. Although the country has depended upon hydropower to meet much of its energy needs, coal could become a more reliable form of energy in the near term, based on estimated indigenous resources and proximity to food quality imports. Thus, trade opportunities exist for the United States, in the electric power sector, for the US advanced fossil fuel technologies and related services. This report describes the Costa Rican energy situation; examines the financial, economic, and trade issues; and discusses project opportunities in Costa Rica. Costa Rica appears to have a positive climate for trade and investment activities, stimulated by the Caribbean Basin Initiative. Although the economy has recently alowed, the economic outlook appears healthy. Application for membership in the General Agreement on Tariffs and Trade is pending. Due to an unexpectedly large growth in electricity demand, the Costa Rican utility Instituto Costarricense de Electricidad is evaluating the need for construction of a coal-fired power plant in the size range of 60 to 125 MW, with an in-service data of the mid-1990s. A decision is expected by the end of 1988 concerning the required size, source of coal, and timing of this coal-fired plant. Based on conditions in Costa Rica, US advanced fossil-fuel technologies were chosen for continued study in conjunction with the identified potential project opportunities. These technologies are the atmospheric fluidized bed combustor and coal-water mixtures. They could play a major role in meeting the utility expansion and/or industrial conversion opportunities summarized in Table I.1. The value of such projects could approximate US $160 million.

46692 (EUR—11360) Exploitation and utilization of hydrocarbons: Final report. Jonchere, J.P.; Seguret, J.; Vachez, F.; Faucher, B. (Commission of the European Communities, Luxembourg; Institut Francais du Petrole (IFP), 92 - Rueil-Malmaison). 1988. 263p. (EN;FR). NTIS (US Sales Only), PC A14; 1; GPO Dep. Order Number DE88012626/JAW.

In order to better define the most urgent research needs in the large field of exploitation, production and utilization of hydrocarbons, the Commission of the European Communities instigated a study by the Bureau d'Etudes Industrielles et de Cooperation del l'Institut Francais du Petrole (BEICIP). In this they established the views of governmental bodies, research organizations, petroleum, gas and chemical producers and the transport industry. The principal lines of research suggested by these bodies are described in this report. This study might be used as a guideline for the preparation of a research and development programme in the area of the optimisation of the production and utilization of hydrocarbons.

46693 (NP—8770275) MMV figures on petroleum 1987. (Mineraloelwirtschaftsverband e.V., Hamburg (Germany, F.R.)). 1988. 52p. (In German). NTIS (US Sales Only), PC A04/MF A01. Order Number DE88770275/JAW.

Tables are presented containing the most important figures of the petroleum industry worldwide, in Europe, and in West Germany. Subjects: Capacities, petroleum supply, petroleum consumption, petroleum exports, petroleum prices, energy consumption, world petroleum figures.

2960 Electric Power

REFER ALSO TO CITATION(S) 47343

46694 (DOE/EIA—0191(87)) Cost and quality of fuels for electric utility plants, 1987. (USDOE Energy Information Administration, Washington, DC. Office of Coal, Nuclear, Electric and Alternate Fuels). 19 Jul 1988. 225p. NTIS, PC A10/MF A01 - GPO; 1; GPO Dep. Order Number DE88014878/JAW.

In 1987, electric utilities received 721.3 million short tons of coal, 34.3 million short tons more than in 1986. Higher coal consumption levels, new coal-fired units entering commercial operation, and a buildup of coal stocks contributed to this record demand for coal by electric utilities. Petroleum receipts at electric utilities in 1987 totaled 194.6 million barrels, 15% less than the 228.5 million barrels received in 1986. Part of the decrease in petroleum receipts in 1987 can be attributed to the higher price charged for No. 6 fuel oil. The 1987 gas receipts at electric utilities totaled 2,666.9 billion cubic feet (Bcf), 229.1 Bcf (9%) more than the 1986 receipts. Unlike petroleum, the average price of gas receipts at electric utilities declined in 1987. The resulting price differential of 74 cents per million Btu (No. 6 oil, 297.4; gas, 223.5) made gas a likely alternative to higher priced petroleum at electric utilities capable of burning either fuel. 52 tabs.

46695 (DOE/EIA—0226(88/04)) Electric power monthly, April 1988. (USDOE Energy Information Administration, Washington, DC. Office of Coal, Nuclear, Electric and Alternate Fuels). 18 Jul 1988. 46p. NTIS, PC A03/MF A01 - GPO; 1; GPO Dep. Order Number DE88014880/JAW.

Total net generation by electric utilities in the United States for the month of April 1988 was 195,818 gigawatthours, 3 percent higher than the amount reported a year ago. Temperatures were cooler than normal and cooler than in April 1987 across most of the nation, resulting in a stronger demand for electricity. Electric utilities reported higher levels of net generation from nuclear and coal-fired plants during April 1988, 20 and 3 percent, respectively, above what was reported during the same period last year. Net generation from hydroelectric, petroleum, and gas-fired plants was lower during the month, by 13, 5, and 2 percent, respectively, compared with April 1987. For the second month in a row, nuclear plants produced 20.5 percent of the total US net generation. Coal remained the leading energy source in the production of electricity in the nation, producing 55.6 percent of the total US net generation during April 1988. For the 11th consecutive month, hydroelectric plants have produced under 10 percent of the total US net generation (9.8 percent during April 1988). 10 refs., 1 fig., 27 tabs.

46696 **(DOE/EIA—0397(88/1Q)) Electric power quarterly: January-March 1988.** (USDOE Energy Information Administration, Washington, DC. Office of Coal, Nuclear, Electric and Alternate Fuels). 22 Jul 1988. 303p. NTIS, PC A14/MF A01 - GPO; 1; GPO Dep. Order Number DE88014877/JAW.

The Electric Power Quarterly (EPQ) presents information on electric utilities at the plant level. The information provides the following: cost, quantity, and quality of fossil fuel receipts; net generation; fuel consumption; and fuel stocks. The EPQ contains monthly data and quarterly totals for the reporting quarter. These data are published to provide meaningful, timely, objective, and accurate energy information for a wide audience including Congress, federal, and state agencies; industry; and the general public. In this report, data regarding electric utilities' net generation, fuel consumption, and fuel stocks are presented on a plant-by-plant basis. In addition, quantity, cost, and quality of fossil-fuel receipts are presented on a plant-by-plant basis for plants with a combined installed nameplate capacity of 50 megawatts or larger.

46697 **(NEI-DK—90) Technologies to increase end-use electricity efficiency.** Noergaard, J. (Danmarks Tekniske Hoejskole, Lyngby. Fysisk Lab. 3). Sep 1986. 13p. (CONF-8609436—1). NTIS (US Sales Only), PC A03/MF A01. Order Number DE88754083/JAW.

From INRIC energy seminar; Budapest, Hungary (8 Sep 1986).

Before starting to analyze future needs for energy, it is important to point out that we cannot as human beings benefit directly from consuming energy, when we exclude food energy as is done in most energy planning. But energy can provide some comfort and other energy services like warm rooms in the winter, cold beer in the summer, clean clothes, illumination, vegetables, fabrics, and warm meals, and thereby indirectly satisfy human needs. When looking for ways to reduce energy consumption, one can suggest to cut the energy services such as lowering room temperatures, walking instead of driving a car, less light in the streets, and slower replacement of durable goods. Many such proposals make good sense and do not necessary lead to a lower quality of life, often the opposite/sup (1)/. However, in this paper we will not consider such cuttings in energy services, but rather look at the options for saving energy by improving the efficiency of the technology used to provide the services. 10 refs.

46698 (OME—2121983, pp 12) **Policy and activities. Government of Canada.** Barclay, J.C. (Dept. of Energy, Mines and Resources, Canada). 2 Dec 1983. CANMET/TID, Energy, Mines and Resources Canada, 555 Booth St., Ottawa, Ont., Canada K1A 0G1; $0.34CAN per page, $3.40 CAN minimum. (CE—01648; CONF-8311312—).

From Small hydro workshop; Toronto, Canada (30 Nov 1983).

The purpose of this paper is to present an overview of the extent of Canadian government involvement in the small hydro field through its policy and program activities and legislative actions. The government's interest in the technology's potential is evident in the wide breadth of involvement and activities of federal departments and agencies. Recent interest by Energy, Mines and Resources (EMR) in small hydro originated in 1977, when the Federal government agreed to provide funding for a 440 kW demonstration at Roddickton, Nfld. Since 1978, EMR has participated in funding agreements for conservation and renewable energy projects with provincial governments across Canada which, among other things, have provided funding for the demonstration of small hydro technology. EMR is also active in programs to study hydro feasibility in remote areas, and it administers a capital cost allowance program for writeoffs on certain assets including small hydro generating equipment. Other agencies involved in some way with small hydro are the Department of Indian Affairs and Northern Development (small hydro for remote native communities), Environment Canada (environmental aspects), Canada Mortgage and Housing, and the National Research Council (testing, research and development on turbines and other equipment). In general, studies on site potential are dictated by economic considerations and have focused on sites with high head/flow conditions, near to existing power lines or near to remote load centers. Small hydro is seen as having a clearly significant strategic value for energy supply in remote communities.

46699 **(ORNL—6421) Mid-term evaluation of USAID [US Agency for International Development] Sudan Energy Planning and Management Project (650-0059).** Jones, D.W.; Stovall, J.P.; Raby, J.G.; Younger, D.R.; Pryor, C.A. (Oak Ridge National Lab., TN (USA)). Jun 1988. Contract AC05-84OR21400. 150p. NTIS, PC A07/MF A01; 1; GPO Dep. Order Number DE88013330/JAW.

In 1984, the United States Agency for International Development's mission in Sudan implemented the Energy Planning and Management Project to strengthen several key institutions in the energy sector of Sudan. One component of the project focused on improving management, billing and collection, pricing, purchasing and stores, and vehicle operation and maintenance in the National Electricity Corporation. The other major component was devoted to strengthening the capability of the National Energy Administration to conduct national energy planning studies, including the analysis of energy issues and policies and the recommendation of policies. Originally the planned date for the midterm evaluation of this project was early 1986, but because political turmoil and other events impeded implementation of the project, that evaluation was only conducted in January and February 1987. ORNL, at the request of the Sudan Mission and the office of Energy of AID, fielded a team in January 1987 to evaluate the progress of the project to that date and make recommendations for the remainder of the project's implementation. This study reports the findings and recommendations of the evaluation team regarding the Sudan Energy Management and Planning Project. 84 refs., 2 figs., 6 tabs.

46700 **(PB—88-155080/XAB) Power plant cumulative environmental-impact report, January 1984.** Miller, P.E. (Maryland Power Plant Research Program, Annapolis (USA)). Jan 1984. 386p. (PPSP/CEIR—4). NTIS, PC A17/MF A01.

See also report dated Feb 82, PB—82-219437.

The Cumulative Environmental Impact Report (CEIR) is a compilation of all studies relating to the impact of power plants in Maryland and adjacent states upon Maryland's environment. The present report is an assessment of impacts using the results of studies performed in 1981 and 1982. Topics discussed in detail in this edition are: (1) Electric Power Supply and Demand, (2) New Approaches to Meeting Power Demands, (3) Air Impacts, (4) Aquatic Impact, (5) Radiological Impact, (6) Socioeconomic Impact, (7) Coal Ash Management, and (8) Groundwater Impact.

2980 Consumption And Utilization

REFER ALSO TO CITATION(S) 46308, 46679, 46695

46701 **(UCLDE-DP—87-24) Fuel and the family expenditure survey.** Baker, P.; Micklewright, J. (University Coll., London (UK). Dept. of Economics). Jul 1987. 70p. British Library, Document Supply Centre, Boston Spa, Wetherby, West Yorks. LS23 7BQ.

This Working Paper contains two reports on data used in our ESRC supported research on modelling individual household demand for gas and electricity into household energy demand in

Great Britain. The first report describes the type of information available in the Family Expenditure Survey whilst the second report presents some descriptive statistics from these data.

2990 Unconventional Sources And Power Generation

REFER ALSO TO CITATION(S) 46513

46702 **(PIRSEM—2027) Juridical conditions for the access to renewable energies.** Colson, J.P.; Faberon, J.Y.; Jamet, J. (Centre National de le Recherche Scientifique, 75 - Paris (France). Programme Interdisciplinaire de Recherche sur les Sciences pour l'Energie et les Matieres Premieres). 1985. 215p. (In French). NTIS (US Sales Only), PC A10/MF A01. Order Number DE88754213/JAW.

Juridical aspects of renewable energy prospecting, mining or production, and utilization are reviewed and analysed (in the French context). The urbanistic and building construction constraints concerning the solar energy reception in a residential building are discussed. The various incitements (subventions, subsidies, fiscality...) for the development of renewable energies in France are also reviewed with the example of the french energy conservation agency (AFME).

30 DIRECT ENERGY CONVERSION

3001 Mhd Generators

46703 **(DOE/FE—0104) MHD [magnetohydrodynamics] program plan, FY 1988.** (USDOE Assistant Secretary for Fossil Energy, Washington, DC). Apr 1988. 38p. NTIS, PC A03/MF A01; 1; GPO Dep. Order Number DE88009233/JAW.

The essential elements of the current program, which are based on the June 1984 Coal-Fired MHD Preliminary Transition and Program Plan, are to: (1) develop technical and environmental data for the integrated MHD topping cycle system through long-term (1000 hours) POC testing; (2) develop technical and environmental data for the integrated MHD bottoming cycle subsystem through long-term (4000 hours) POC testing; (3) design and construct a seed regeneration system capable of independent operation, using spent seed materials from the MHD process; (4) prepare a conceptual design for an MHD retrofit plant; and (5) continue system studies and supporting research necessary for system testing. Results of the topping cycle POC tests at the Component Development and Integration Facility (CDIF), coupled with the bottoming cycle POC test results obtained at the Coal Fired Flow Facility (CFFF), and the seed regeneration POC effort will provide the critical engineering data base for the private sector's final decision on proceeding with the design, construction, and operation of an MHD retrofit. The development schedule, decision points, and resource requirements are shown in Exhibit 3. The current MHD program is directed toward base-load, both stand-alone and retrofit, coal-fired power plant application. Development of a base-load utility plant should enhance development of MHD for other utility and industrial applications. MHD may also find application in the electrical energy intensive industries. 7 figs.

3005 Fuel Cells

46704 (CONF-861008—Absts., pp 48-51) **Oxide electrodes for solid oxide fuel cells.** Bates, J.L.; Griffin, C.W. (Battelle Memorial Institute, Richland, WA (USA)). Oct 1986. NTIS, PC A 17. Order Number DE88008298/JAW. Contract AC06-76RL01830.

From Fuel cell seminar; Tucson, AZ, USA (26 Oct 1986).

State of the art solid oxide fuel cells (SOFC) use different materials metals as electrodes, electrolytes and current interconnections, i.e. chromites, manganites, zirconates, metal-composites and nickel. These materials exhibit different properties unless modified, may require different, multiple-step fabrication process conditions and are susceptible to degrading chemical and electrochemical interactions. High-temperature oxides materials based on rare-earth (RE/sub x/O/sub y/) stabilized ZrO_2 (or HfO_2) are being studied as advanced SOFC electrode and interconnection materials. The objective is to develop high-electronically conducting oxide materials with thermal and fabrication characteristics similar to the solid electrolyte. Ionically conducting Y_2O_3 or RE/sub x/O/sub y/ stabilized ZrO_2 (HfO_2) solid electrolytes are made electronically conducting with additions of other oxides, e.g., In_2O_3, with structures similar to the fcc electrolyte. These related structures may provide: (1) thermal expansion match with electrolyte, (2) simultaneous fabrication of electrode/electrolyte as integral cell component, (3) compositions which minimize material interactions between SOFC components, and (4) improved electrode/electrolyte reaction rates. These same materials may also be used as current connections for similar reasons. This paper describes the research and development of materials based on the ZrO_2-PrO_2(RE/sub x/O/sub y/)-In_2O_3 system as electrodes and current interconnections for SOFC. The electrical transport and thermal properties are described in relationship to structure, phase equilibria and composition. Some compositions containing HfO_2 which are isomorphic with the ZrO_2 systems are also discussed.

46705 **(DOE/ER/45247—2) Surface chemistry of electrocatalysts: Annual technical progress report, July 1986-November 1987.** Hubbard, A.T. (Cincinnati Univ., OH (USA). Dept. of Chemistry). 1987. Contract FG02-86ER45247. 22p. NTIS, PC A03/MF A01; 1; GPO Dep. Order Number DE88014129/JAW.

It is proposed to determine the identity and electrochemical reactivity of the species present at electrocatalyst surfaces after pretreatment and use in solutions of hydrocarbons. A representative selection of hydrocarbons will be studied including potential fuels, intermediates, products, catalyst modifiers, solvents, electrolytes and poisons. Electron energy-loss (EELS) spectra have been obtained of organic molecules adsorbed from aqueous electrolytes on Pt single crystal surfaces. Reduction products from adsorbed organic sulfur compounds at polycrystalline Pt electrodes were identified. Electrocatalytic oxidation of aromatics was also studied, as was bromine adsorption at Pt electrodes and metallization of electrocatalyst surfaces. (CBS)

46706 **(DOE/METC—88/6091) Fuel cells: A bibliography.** (USDOE Morgantown Energy Technology Center, WV; USDOE Office of Scientific and Technical Information, Oak Ridge, TN). May 1988. 340p. (DOE/OSTI—3359-Suppl.3). NTIS, PC A15/MF A01; 1; GPO Dep. Order Number DE88001081/JAW.

This bibliography includes 1392 citations of domestic and foreign reports, journal articles, patents, conference papers and proceedings and books. The citations were taken from the DOE Energy Data Base covering the period March 1985 through February 1988. These citations are arranged in the following six subject categories: general; design and development; performance testing; materials, components, and auxiliaries; applications; and electrochemistry, mass transfer, and thermodynamics. Within each category, the report citations are arranged alphanumerically by report numbers, and nonreport literature citations are arranged in reverse chronological order. Indexes are provided for corporate author, personal author, subject, contract number, and report number. (AT)

46707 **(PNL—6575) Advanced materials for solid oxide fuel cells: Hafnium-Praseodymium-Indium Oxide System.** Bates, J.L.; Griffin, C.W.; Weber, W.J. (Pacific Northwest Lab., Richland, WA (USA)). Jun 1988. Contract AC06-76RL01830. 51p. NTIS, PC A04/MF A01; 1; GPO Dep. Order Number DE88015365/JAW.

The HfO_2-PrO/sub 1.83/-In_2O_3 system has been studied at the Pacific Northwest Laboratory to develop alternative, highly electrically conducting oxides as electrode and interconnection materials for solid oxide fuel cells. A coprecipitation process was developed for synthesizing single-phase, mixed oxide powders necessary to fabricate powders and dense oxides. A ternary phase diagram was developed, and the phases and structures were related to electrical transport properties. Two new phases, an orthorhombic $PrInO_3$ and a rhombohedral $Hf_6In_2O_7$ phase, were identified. The highest electronic conductivity is related to the presence of a bcc, In_2O_3 solid solution (ss) containing HfO_2 and PrO/sub 1.83/. Com-

positions containing more than 35 mol % of the In_2O_3 as have electrical conductivities greater than 10/sup {minus}1/ (ohm-cm)/sup {minus}1/, and the two or three phase structures that contain this phase appear to exhibit mixed electronic-ionic conduction. The high electrical conductivities and structures similar to the Y_2O_3-stabilized $ZrO_2(HfO_2)$ electrolyte give these oxides potential for use as cathodes in solid oxide fuel cells. 21 refs.

32 ENERGY CONSERVATION, CONSUMPTION, AND UTILIZATION

46708 (ORNL—6475/V2) Energy Division annual progress report for period ending September 30, 1987: Volume 2. (Oak Ridge National Lab., TN (USA)). Jun 1988. Contract AC05-84OR21400. 251p. NTIS, PC A12/MF A01; 1; GPO Dep. Order Number DE88013341/JAW.

The goals and accomplishments of the Energy Division of Oak Ridge National Laboratory are described in this annual progress report for FY 1987. The Energy Division had five major purposes, pursued through research, analysis, information dissemination, and management: (1) contribute to the effective resolution of energy-related issues, (2) conduct fundamental and applied research to improve decision-making processes, (3) improve the productive use of energy, (4) improve the effectiveness of electric power systems, and (5) achieve excellence in energy-related social science research. Consistent with the major purposes of the Division, the current research programs focus on four major areas: (1) analysis and assessment, (2) decision system research, (3) energy conservation aimed at improving energy end-use technologies, and (4) electric power systems.

3201 Buildings

REFER ALSO TO CITATION(S) 46504, 46507, 46681, 46682, 46686, 46702, 47219

46709 (AFME—84-0018) Energetic evaluation of the in-situ operation of the E.S.A. society Presence Eco system. (Agence Francaise pour la Maitrise de l'Energie, 75 - Paris). 1986. 215p. (In French). NTIS (US Sales Only), PC A10/MF A01. Order Number DE88754211/JAW.

The Presence Eco energy conservation system for space heating is presented and evaluated in a school building. The device is installed in each room and controls, in an all-or-nothing way, the radiators and convectors. It is connected to a daily or weekly programmed clock but it may be also manually started (attesting the presence of a person in the room). The experimental tests showed a 16 percent energy saving per year but this rate could be enhanced by a more rigorous maintenance of the heating equipment.

46710 (CONF-880627—3) Laboratory examination and seasonal analyses of the dynamic losses for a continuously variable speed heat pump. Miller, W.A. (Oak Ridge National Lab., TN (USA)). 1988. Contract AC05-84OR21400. 30p. NTIS, PC A03/MF A01; 1; GPO Dep. Order Number DE88013207/JAW.

From ASHRAE annual meeting; Ottawa, Canada (25 Jun 1988).

An air-to-air split-system, continuously variable speed heat pump of nominal; 2-1/2 ton (8.8 kW) cooling capacity was instrumented and tested in this laboratory. The system operating conditions, coefficient of performance, and system capacity were measured during frosting/defrosting tests and during both heating and cooling mode cycling tests. Frosting/defrosting tests were conducted for a range of compressor speeds, outdoor air temperatures, and relative humidities. Cycling tests were conducted for a range of compressor speeds and outdoor temperatures. Dynamic loss algorithms were developed from the data and seasonal analysis simulations were made to estimate the potential energy savings due to compressor and indoor blower modulation. For Ft. Worth (Tex.), Knoxville (Tenn.), and Syracuse (N.Y.), analysis of energy cost savings due to modulation justify a cost premium of $400 for three-year payback. 14 refs., 12 figs., 7 tabs.

46711 (CONF-880814—8) Patterns of electric water heater use and the effects of water heater load control on customers. Reed, J.H.; Broadwater, R.P.; Chandrasekaran, A.; Thompson, J. (Oak Ridge National Lab., TN (USA); Tennessee Technological Univ., Cookeville (USA)). 1988. Contract AC05-84OR21400. 13p. Unlimited audience, publicly available.; 1; GPO Dep. Order Number DE88015296/JAW.

From Summer study on energy efficiency in buildings; Pacific Grove, CA, USA (28 Aug 1988).

How customers use hot water and how water is heated is a significant issue. It is particularly salient since electric utilities are experiencing intense competition from the gas industry for the residential users' energy dollars for water heating. For many utilities, residential water heating is a significant contributor to system peak demands. Thus, the cost of generating the electricity to heat water is often relatively expensive. Further, this coincidence between the water heating peak and system peak often contributes to the need for expensive peaking capacity. This paper reports on the analysis of the water heater load control experiments conducted as part of the Athens Automation and Control Experiment (AACE). The analysis is based on data from end-use monitoring devices as well as survey data. A total of 36 water heaters were monitored during the winter months of 1986/87. 4 refs., 9 figs.

46712 (CONF-8804100—3) Evaluation of nonazeotropic refrigerant mixtures for capacity modulation. Vineyard, E.A.; Sand, J.R. (Oak Ridge National Lab., TN (USA)). 1988. Contract AC05-84OR21400. 10p. NTIS, PC A02/MF A01; 1; GPO Dep. Order Number DE88013244/JAW.

From 2. DOE/ORNL heat pump conference: research and development on the heat pump for space conditioning applications; Washington, DC, USA (17 Apr 1988).

A test program is underway at the Oak Ridge National Laboratory (ORNL) to evaluate the potential performance improvements from using nonazeotropic refrigerant mixtures in residential heat pumps. The goals of the research effort are to achieve (1) capacity control by adjusting the composition, (2) increased capacity, relative to R22, at low ambient temperatures, and (3) matching of the refrigerant temperature differentials to the source and sink fluid temperature differentials. Performance improvements are expected to result from decreasing the cycling losses and the amount of resistance heat required at low ambient temperatures along with reducing the irreversibilities in the heat exchangers. Initial results for a mixture of R13B1/R152a show a potential capacity modulation from 12431 Btu/h (3643 W) at 17 F ({minus}8.3{degree}C) to 8550 Btu/h (2506 W) at 47 F (8.3{degree}C) in heating and from 7451 Btu/h (2184 W) at 82 F (27. 8{degree}C) to 9188 Btu/h (2693 W) at 95 F (35{degree}C) in cooling. Other refrigerant pairs which are safer from an ozone depletion standpoint are under consideration for later testing. 10 refs., 5 figs., 4 tabs.

46713 (CONF-8804100—4) An analytical study of hybrid ejector/internal combustion engine-driven heat pumps. Murphy, R.W. (Oak Ridge National Lab., TN (USA)). 1988. Contract AC05-84OR21400. 8p. NTIS, PC A02/MF A01; 1; GPO Dep. Order Number DE88013242/JAW.

From 2. DOE/ORNL heat pump conference: research and development on the heat pump for space conditioning applications; Washington, DC, USA (17 Apr 1988).

Because ejectors can combine high reliability with low maintenance cost in a package requiring little capital investment, they may provide attractive heat pumping capability in situations where the importance of their inefficiencies is minimized. One such concept, a hybrid system in which an ejector driven by engine reject heat is used to increase the performance of an internal combustion engine-driven heat pump, was analyzed by modifying an existing ejector heat pump model and combining it with generic compressor and internal combustion engine models. Under the model assumptions for nominal cooling mode conditions, the results showed that hybrid systems could provide substantial performance augmentation{emdash}up to 17{percent} increase in system coefficient of performance for a parallel arrangement of an enhanced ejector with the engine-driven compressor. 4 refs., 4 figs., 4 tabs.

46714 **(CONF-8804100—6) Engine driven heat pump program overview.** Privon, G.T.; Braun, A.T. (Oak Ridge National Lab., TN (USA)). 1988. Contract AC05-84OR21400. 8p. NTIS, PC A02. Order Number DE88013240/JAW.

From 2. DOE/ORNL heat pump conference: research and development on the heat pump for space conditioning applications; Washington, DC, USA (17 Apr 1988).

This overview presentation is a brief summary of the efforts that have taken place in the small commercial-sized internal combustion engine-driven heat pump project being carried out by the Oak Ridge National Laboratory for the Department of Energy. Aspects of the project discussed are: objectives and effort scope, the engine- compressor-seal concept, early results, recent developments, current status, and future plans. 6 refs., 5 figs.

46715 **(CONF-8804100—8) Evaluation of vapor compression cycles using nonazeotropic refrigerant mixtures.** Merriam, R.L. (Little (Arthur D.), Inc., Cambridge, MA (USA)). 1988. Contract AC05-84OR21400. 12p. NTIS, PC A03/MF A01; 1; GPO Dep. Order Number DE88013225/JAW.

From 2. DOE/ORNL heat pump conference: research and development on the heat pump for space conditioning applications; Washington, DC, USA (17 Apr 1988).

A comprehensive investigation is carried out, on a systematic and consistent basis, to explore a range of advanced heat pump cycle concepts using nonazeotropic refrigerants for COP enhancement and capacity modulation along with the trade-offs associated with refrigerant mixture selection. The objectives of the study were to: identify candidate nonazeotropic mixtures and advanced heat pump cycle concepts with emphasis on their potential for single-speed capacity modulation with mixture composition control; assess the effect of conjunction with nonazeotropic mixture cycles; evaluate the cycles analytically and recommend the most promising cycles and mixtures for further development; and provide recommendations relating to the needs for additional refrigerant property data, experimental studies of basic heat transfer phenomena with mixed refrigerants, development of system components, and/or more detailed modeling of specific components. 18 refs., 7 figs., 3 tabs.

46716 **(CONF-8804100—9) Evaluation of a commercial advanced absorption heat pump breadboard.** Modahl, R.J.; Hayes, F.C. (Trane Co., La Crosse, WI (USA)). 1988. Contract AC05-84OR21400. 10p. NTIS, PC A02. Order Number DE88013206/JAW.

From 2. DOE/ORNL heat pump conference: research and development on the heat pump for space conditioning applications; Washington, DC, USA (17 Apr 1988).

An advanced absorption heat pump program is being conducted by the Trane Company, with support from the US Department of Energy. The overall objective of the program is the evaluation, development, and proof testing of advanced absorption refrigeration cycles which are applicable to residential and commercial heat pumps for space conditioning. The heat pump system is to be direct fired with natural gas, and to use working fluids whose properties are known. Target Coefficient of Performance (COP's) are 1.6 at 47{degree}F and 1.2 at 17{degree}F in the heating mode, and 0.7 at 95{degree}F in the cooling mode, including the effect of flue losses. The overall project is divided into three phases. Phase I was the analytical evaluation of advanced cycles, and included selection of preferred concepts for further development. Phase II involved the development and testing of critical components and breadboard version of the selected system. Phase III is the development of a prototype unit and is contingent on successful completion of Phase II. This paper summarizes the results of the Phase II work. 6 figs., 2 tabs.

46717 **(CONF-8804100—14) Development of a residential free-piston Stirling engine heat pump.** Ackermann, R.A. (Mechanical Technology, Inc., Latham, NY (USA)). 1988. Contract AC05-84OR21400. 8p. NTIS, PC A02/MF A01; 1; GPO Dep. Order Number DE88012917/JAW.

From 2. DOE/ORNL heat pump conference: research and development on the heat pump for space conditioning applications; Washington, DC, USA (17 Apr 1988).

After several years of development, the free-piston Stirling engine heat pump (FPSE/HP)has successfully demonstrated proof-of-concept targets. The performance targets were achieved during an off-site test and evaluation program conducted at the Lennox Industries Engineering Center. The performance achieved for the module was a cooling thermal coefficient of performance (COP) of 0.91 and a heating thermal COP of 1.62. In addition to its performance achievement, the FPSE/HP module demonstrated good reliability in over 60 days of operation and ran stably and repeatably over a range of ambient conditions from 0 to 105{degree}F. This paper will provide a description of the FPSE/HP module tested at Lennox, describe the developmental history of the FPSE/HP at Mechanical Technology Incorporated (MTI), and present the results of the Lennox tests. This work has been a collaborative effort between MTI, Oak Ridge National Laboratory (ORNL), the Department of Energy (DOE), and the Gas Research Institute (GRI). The financial and technical support provided by ORNL, DOE, and GRI was responsible for the success achieved. 13 figs., 3 tabs.

46718 **(CONF-8804100—19) Preliminary assessment of a magnetically coupled free-piston Stirling engine heat pump compressor.** Beale, W.T.; Chen, G. (Oak Ridge National Lab., TN (USA); Sunpower, Inc., Athens, OH (USA)). 1988. Contract AC05-84OR21400. 6p. NTIS, PC A02/MF A01; 1; GPO Dep. Order Number DE88013835/JAW.

From 2. DOE/ORNL heat pump conference: research and development on the heat pump for space conditioning applications; Washington, DC, USA (17 Apr 1988).

The potential advantages of direct magnetic coupling of a free-piston Stirling engine with a vapor compressor are being investigated experimentally. Results to date indicate no problems with dynamics, mechanical arrangements, efficiency or deterioration. The problems of size and cost remain, but these are determined by the properties of the magnetic material, which are improving rapidly. If the magnet material becomes available at a satisfactory price, the work undertaken here will facilitate a commercially attractive magnet drive system. 4 figs.

46719 **(EI—111981) Utility bills vs sub-metering for the assessment of annual energy consumption in buildings cost and uncertainty analysis.** (Engineering Interface Ltd., Willowdale, Ontario (Canada)). Nov 1981. 43p. (CE—01694). CANMET/TID, Energy, Mines and Resources Canada, 555 Booth St., Ottawa, Ont., Canada K1A 0G1; $0.34CAN per page, $3.40 CAN minimum.

The purpose of this report was to evaluate two approaches to the collection of component energy usage in low energy buildings. These are application of energy use computer programs using data from existing utility billing meters, and installation of extra meters to sub-meter building fuel and electrical systems. A Toronto office building was chosen as a working example for this report, and its characteristics and the operation of the various components are described. The two collection methods are compared for cost, resolution, accuracy, and applicability to other buildings. For the particular building studied, the sub-metering option was estimated to cost $30,000-40,000 in capital cost plus $8,000/y in operating cost; the computer audit option had no capital cost, and was estimated at $5,000/y. The sub-metering method provides finer resolution of individual load components; the computer method can determine the major energy components with only 2 degrees of resolution (seasonal and base loads, and components of those loads). The accuracy of the sub-metering method depends on the type of meter used, with typical accuracy for each sub-metered component within 1.5%. With the computer method, accuracy will vary with different buildings and will be a function of the number of components desired, their relative magnitude, amount of detail in the audit, consistency of building operation profiles, and presence of energy management systems. For the building studied, accuracies were estimated to range from 2% for boilers to 60% for miscellaneous equipment and elevators. The report recommends the computer method for its lower cost, shorter project time and other factors. 22 figs.

46720 **(EPRI-EM—5896) Energy use, air infiltration, and indoor air quality in well-insulated residences: Final report.** Nagda, N.L. (Electric Power Research Inst., Palo Alto, CA (USA); GEOMET Technologies, Inc., Germantown, MD (USA)). Jun 1988. 26p. Unlimited audience, publicly available. Research Reports Center, Box 50490, Palo Alto, CA 94303. Order Number TI88012777/JAW.

Two bilevel houses of identical design and construction were studied to determine the relationships among air exchange, energy consumption, and indoor pollutants. The experimental house was retrofitted to increase building tightness and was equipped with an air-to-air heat exchanger; the control house was kept in its initial state of construction. The two houses were monitored both before and after the experimental house was tightened. The tightening resulted in a reduction of air leakage and air infiltration and a savings in heating energy, but an increase in radon and radon progeny. The impact of the tightening on other monitored indoor pollutants—carbon monoxide, nitrogen dioxide, formaldehyde, and inhalable particulates—was fairly small under study conditions. In general, the levels of all pollutants measured in these two houses were relatively low in relation to existing guidelines for pollutant concentrations. It was found that the air-to-air heat exchanger could generally improve indoor air quality. However, comparable alternatives to the heat exchanger were also found for most pollutants. Algorithms and models were developed that explained 60 to 90 percent or more of the variations in air infiltration, energy use, and indoor pollutant concentrations. 9 figs., 6 tabs.

46721 **(LBL—22315-1/2) Indoor air quality and ventilation measurements in 38 Pacific Northwest commercial buildings: Final report: Volume 1, Measurement results and interpretation.** Turk, B.H.; Brown, J.T.; Geisling-Sobotka, K.; Froehlich, D.A.; Grimsrud, D.T.; Harrison, J.; Koonce, J.F.; Prill, R.J.; Revzan, K.L. (Lawrence Berkeley Lab., CA (USA)). Dec 1987. Contract AC03-76SF00098;AI79-83BP12921. 147p. NTIS, PC A07/MF A01; 1; GPO Dep. Order Number DE88014064/JAW.

Specific study objectives include: The characterization of a variety of indoor pollutant concentrations and ventilation rates in 38 commercial and institutional buildings in the Pacific Northwest. Buildings were to be selected from existing stock and not necessarily exhibit symptoms of poor air quality, the investigation of the relationships between observed indoor air pollutant levels and ventilation rates. Findings from this study indicate that for most pollutants that were monitored only a few percent of the sites monitored have concentrations exceeding recommended guidelines. The exception, respirable suspended particles (RSP), often exceed ambient air quality standards for total suspended particles (TSP) in smoking areas. Since RSP are only a subset of the total suspended particles, this is a significant observation. Ventilation rates average higher than those typically observed in residences and appeared to have very poor correlation to the generally low pollutant concentrations. 64 refs., 46 figs., 30 tabs.

46722 **(LBL—23279) Energy and economic analyses in support of energy conservation standards for new commercial buildings in Malaysia.** Deringer, J.J.; Busch, J.F.; Hall, J.; Kannan, K.S.; Levine, M.D.; Ayub, A.C.; Turiel, I. (Lawrence Berkeley Lab., CA (USA)). Apr 1987. Contract AC03-76SF00098. 86p. NTIS, PC A05/MF A01; 1; GPO Dep. Order Number DE88014062/JAW.

This report documents energy and economic analyses in support of Malaysian efforts to develop an energy standard for buildings. The Malaysian research discussed in this report has been developed exclusively for new commercial buildings. Research on this project has been carried out by a team of Energy Consultants from Malaysia and from Lawrence Berkeley Laboratory in close consultation with the Malaysian Government. Since September 1986, the team has conducted numerous computer simulations and analyses of energy consumption in typical buildings based on Malaysian weather, building construction, and cost data. The energy conservation policies evaluated in this research include criteria for: lighting power and controls; air conditioning (A/C) equipment; building envelope thermal performance; and, credits for the use of daylighting. 16 refs., 18 figs., 10 tabs.

46723 **(LBL—23429) A comparison of indoor air quality in conventional and model conservation standard new homes in the Pacific Northwest: Final report to the Bonneville Power Administration.** Turk, B.H.; Grimsrud, D.T.; Harrison, J.; Prill, R.J. (Lawrence Berkeley Lab., CA (USA)). 15 Sep 1987. Contract AC03-76SF00098;AI79-83BP12921. 48p. NTIS, PC A04/MF A01; 1; GPO Dep. Order Number DE88014061/JAW.

Ventilation and indoor air quality measurements have been made in 61 new houses located in two regions of the Pacific Northwest. Twenty-nine houses built to Model Conservation Standards (MCS) were compared to 32 Control houses, i.e., new houses built using conventional practices in the region. The MCS houses met the objective of having significantly reduced air leakage area. Yet their their total ventilation rate (infiltration plus mechanical ventilation supplied by air-to-air heat exchangers) was the same as the infiltration rate observed in the sample of Control houses. These ventilation rates in both samples were about 0.03 ach. Indoor pollutant concentrations were observed to be only poorly correlated with ventilation rates, an indication that other variables including pollutant source strengths and occupancy effects may be important. Pollutant measurements made in both samples revealed that 11% of the houses exceeded the EPA guideline of 4 pCi/l. Thirty percent of the total houses exceed the 100 ppB formaldehyde guidelines adopted by many organizations. Indoor pollutant concentrations were seen to vary more between geographic regions than between the two types of house construction. 41 refs., 27 figs., 4 tabs.

46724 **(LBL—23740) Residential air Leakage database compilation: Final report.** Modera, M.P. (Lawrence Berkeley Lab., CA (USA)). Oct 1986. Contract AC03-76SF00098. 19p. NTIS, PC A03/MF A01; 1; GPO Dep. Order Number DE88014059/JAW.

Under contract to the Department of the Army, the Energy Performance of Buildings Group at Lawrence Berkeley Laboratory has compiled a database of residential air leakage measurements. The primary objective of this contract was to compile a readily available sample of the air leakage measurements being performed in North America. The secondary objective was to compile building characteristics and climate data associated with each measurement. This paper reviews the database containing this information. 1 fig.

46725 **(LBL—23887) Monitoring capabilities of energy management systems in commercial buildings.** Cleary, P.G. (Lawrence Berkeley Lab., CA (USA); Royal Inst. of Tech., Stockholm (Sweden)). Jun 1987. Contract AC03-76SF00098. 14p. (CONF-870620—11). NTIS, PC A03/MF A01; 1; GPO Dep. Order Number DE88013603/JAW.

From Annual meeting of the American Society of Heating, Refrigerating and Air-Conditioning Engineers; Nashville, TN, USA (28 Jun 1987).

The Konsolen building is a high thermal mass 57-unit apartment building on the outskirts of Stockholm, Sweden. It is part of the Stockholm Project, a full-scale demonstration of energy-saving techniques. A large number of sensors were installed in the building for research purposes. However, they may not be needed for some types of analysis. It is of interest to see what could be learned if only typical Energy Management Systems (EMS) outputs were available. These include total electricity use, heat output from the heat pump, and heat supplied by the district heating main. It was found that the detailed sensors were essential in debugging the mechanical systems initially, but the EMS-type outputs are quite adequate to confirm that the building continues to operate normally. The building has such stable lumped parameters (average temperature, base load and thermal resistance) that detailed data are not needed to predict the average daily heat demand to within +-10%. However, neither the effect of the solar collectors nor the thermal mass of the building are visible in the EMS-type data. 3 refs., 4 figs., 1 tab.

46726 **(LBL—25521) Technology assessment: Thermal cool storage in commercial buildings.** Piette, M.A.; Wyatt, E.; Harris, J. (Lawrence Berkeley Lab., CA (USA)). Jan 1988. Contract AC03-76SF00098. 54p. NTIS, PC A04/MF A01; 1; GPO Dep. Order Number DE88014043/JAW.

This report, one of a series of end-use energy technology assessment reports, investigates the current and potential use of thermal storage systems for cooling commercial buildings. The aim of these investigations is to synthesize current information from both published and unpublished sources so that utilities, state regulatory commissions, and others can better identify, evaluate, and select demand-site resources to meet their needs. The material covered in these reports is not limited to "success stories" but also includes failures, barriers, uncertainties, and information gaps. In addition, we attempt to identify and, if possible, reconcile variations or discrepancies among data sources. The technology assessment reports are designed to be easily updated in the future as the technologies develop and better data become available. 56 refs., 2 figs., 10 tabs.

46727 **(LUSG-WP—503) Community involvement in local energy strategies.** Sheldrick, B. (Leeds Univ. (UK). School of Geography). Nov 1987. 31p. (CONF-8712105—). British Library, Document Supply Centre, Boston Spa, Wetherby, West Yorks. LS23 7BQ.

From Unhealthy housing conference; Warwick, UK (13 Dec 1987).

Six initiatives intended to intervene in local community energy issues are reviewed. The initiatives are located at Glasgow, Newcastle, Cardiff, Bradford, Hackney and Lewisham. Their objectives and achievements are examined. Effective community involvement is judged to be essential and the experiences gained are discussed.

46728 **(NRC/BR—NRCC19458) Visual performance with realistic methods of changing contrast. Division of Building Research paper No. 986.** Rea, M.S. (National Research Council of Canada, Ottawa, Ontario. Div. of Building Research). 1981. 13p. (CE—01692). CANMET/TID, Energy, Mines and Resources Canada, 555 Booth St., Ottawa, Ont., Canada K1A 0G1; $0.34CAN per page, $3.40 CAN minimum.

Performance at a complex visual task was measured under a set of realistic conditions. These conditions, including variations in the reflective properties of the task and in the lighting geometry, strongly influenced the photometric contrast of the visual task. The data supported the hypothesis that the amount of task contrast, no matter how it was achieved under the set of realistic conditions, determined the level of performance because a single, general transfer function was obtained relating photometric contrast to performance at the task. The general transfer function allowed quantitative predictions of performance under various combinations of ink pigment density, ink specularity, angle of illumination on the task, degree of vertical polarization of the illumination, orientation of the work station relative to the illumination, and viewing angle. Despite the large and complicated interactions that occurred between these factors to change contrast, and thus performance, the latitude for lighting designers and consultants concerned with visual performance may be greater than previously believed. 29 refs., 11 figs., 3 tabs.

46729 **(ORNL/CON—228/P2) Field test evaluation of conservation retrofits of low-income, single-family buildings in Wisconsin: Audit field test implementation and results.** McCold, L.N.; Schlegel, J.A.; O'Leary, L.; Hewitt, D.C. (Oak Ridge National Lab., TN (USA)). Jun 1988. Contract AC05-84OR21400. 77p. NTIS, PC A05/MF A01; GPO Dep. Order Number DE88013343/JAW.

This report describes the field test of a retrofit audit. The field test was performed during the winter of 1985-86 in four south central Wisconsin counties. The purpose of the field test was to measure the energy savings and cost effectiveness of the audit-directed retrofit program for optimizing the program's benefit-to-cost ratio. The audit-directed retrofit program is described briefly in this report and in more detail by another report in this series (ORNL/CON-228/P3). The purpose of this report is to describe the methods and results of the field test. 3 refs., 7 figs., 10 tabs.

46730 **(ORNL/CON—228/P5) Field test evaluation of conservation retrofits of low-income, single-family buildings in Wisconsin: Blower-door-directed infiltration reduction procedure: Field test implementation and results.** Gettings, M.B.; McCold, L.N.; Schlegel, J.A. (Oak Ridge National Lab., TN (USA)). Jun 1988. Contract AC05-84OR21400. 71p. NTIS, PC A04/MF A01; 1; GPO Dep. Order Number DE88013344/JAW.

A blower-door-directed infiltration retrofit procedure was field tested on 18 homes in south central Wisconsin. The procedure, developed by the Wisconsin Energy Conservation Corporation, includes recommended retrofit techniques as performed on a house. A recommended expenditure level and target air leakage reduction, in air changes per hour at 50 pascal (ACH50), are determined from the initial leakage rate measured. The procedure produced an average 16% reduction in air leakage rate. For the 7 houses recommended for retrofit, 89% of the targeted reductions were accomplished with 76% of the recommended expenditures. The average cost of retrofits per house was reduced by a factor of four compared with previous programs. The average payback period for recommended retrofits was 4.4 years, based on predicted energy savings computed from achieved air leakage reductions. Although exceptions occurred, the procedure's 8 ACH50 minimum initial leakage rate for advising retrofits to be performed appeared a good choice, based on cost-effective air leakage reduction. Houses with initial rates of 7 ACH50 or below consistently required substantially higher costs to achieve significant air leakage reductions. 8 refs., 4 figs., 7 tabs.

46731 **(ORNL/M—339) Marketing plan and strategies, Roof Research Center (RRC).** Courville, G.E.; Brewer, J. (Oak Ridge National Lab., TN (USA)). Jun 1988. Contract AC05-84OR21400. 47p. NTIS, PC A03/MF A01; 1; GPO Dep. Order Number DE88013347/JAW.

The US Department of Energy (DOE) has established a Roof Research Center at the Oak Ridge National Laboratory (ORNL). Currently, DOE supports a program that includes laboratory experimental work, analysis, industry assessments, development of measuring procedures, and field performance surveys. The facilities and capabilities of this program are now being made more generally available to the roofing industry through designation of the Roof Research Center (RRC) as a National Users Facility. Within this program, DOE will actively seek multiple sponsorship for projects. It is the purpose of this marketing plan to define a strategy to assure that sufficient outside funding will be attracted to the RRC. Current literature on the roofing industry, existing market research and interviews with industry experts were used to gain information needed in this report. Industry trends, historical research expenditures, product classes and manufacturers in the industry were identified. From this, a list of target firms for the RRC was devised, along with the major publicity influences of this market. The RRC was also analyzed to determine its objectives and capabilities. Opportunities and problems that might occur with outside industry funding were also identified so that these could be addressed in the marketing strategy. 6 refs.

46732 **(ORNL/M—340) Low-slope roofing research needs: An ORNL draft assessment.** Busching, H.W.; Courville, G.E.; Dvorchak, M.; McCorkle, J. (Oak Ridge National Lab., TN (USA)). Aug 1987. Contract AC05-84OR21400. 35p. NTIS, PC A03/MF A01; 1; GPO Dep. Order Number DE88012498/JAW.

The Low-Slope Roofing Research Needs Agenda is a resource document prepared by the Roofing Industry Research Advisory Panel. The document will aid the Panel in developing recommended research priorities and schedules for the Roof Research Center established by the US Department of Energy at Oak Ridge National Laboratory (ORNL). The Roof Research Center provides the roofing industry with a unique test facility capable of careful, on-line measurements on whole roof systems under controlled, simulated in-service conditions. This type of systems testing, however, is not well-developed in the roofing industry where, customarily, careful measurements are not only made to assess individual material properties under design conditions and systems testing generally is limited to "performance testing"; that is, exposing roof systems to

typical or accelerated environments and observing or measuring the time intergrated effects on various components. This document discusses the capabilities of the center and roofing research issues.

46733 **(ORNL/Sub—86-72143/1) Building foundation design handbook.** Labs, K.; Carmody, J.; Sterling, R.; Shen, L.; Huang, Yu Joe; Parker, D. (Oak Ridge National Lab., TN (USA); Minnesota Univ., Minneapolis (USA). Underground Space Center). May 1988. Contract AC05-84OR21400. 357p. NTIS, PC A16/MF A01; 1; GPO Dep. Order Number DE88013350/JAW.

This design handbook contains a concise set of typical residential foundation construction details and recommends cost-effective insulation levels for a variety of basements, crawl spaces, and slab-on-grade foundations for most US regions. The construction details are accompanied by the critical design information needed for specifying structural integrity; thermal and vapor controls; subsurface drainage; waterproofing; backfilling and compaction; and decay, termite, and radon control measures. 402 refs., 122 figs., 97 tabs.

46734 **(PNL-SA—14252) Auxiliary heating in the residential sector.** Reilly, J.M.; Shankle, S.A. (Pacific Northwest Lab., Richland, WA (USA)). Aug 1986. Contract AC06-76RL01830. 35p. NTIS, PC A03/MF A01; 1; GPO Dep. Order Number DE88014075/JAW.

This paper examines the prevalence of dual-fuel capabilities in the residential sector and estimates the intensity of use of this equipment. The Residential Energy Consumption Survey (RECS) data collected by the US Department of Energy (US DOE) are utilized. The report contains: Types of auxiliary and dual-fuel capability equipment; Estimates of the intensity of use of auxiliary equipment; Suggestions for incorporating dual-fuel capability into residential forecast models; and Findings for policy. 21 refs., 8 tabs.

46735 **(SERI/TP—254-3371) International Energy Agency design tool evaluation procedure.** Judkoff, R.; Barakat, S.; Bloomfield, D.; Poel, B.; Stricker, R.; van Haaster, P.; Wortman, D. (Solar Energy Research Inst., Golden, CO (USA); National Research Council of Canada, Ottawa, Ontario; Building Research Establishment, Watford (UK); Bouwcentrum, Rotterdam (Netherlands); Fraunhofer-Institut fuer Bauphysik, Stuttgart (Germany, F.R.); Architectural Energy Corp., Westminster, CO (USA)). Jul 1988. Contract AC02-83CH10093. 8p. (CONF-880615—4). NTIS, PC A02. Order Number DE88001173/JAW.

From Solar '88: American Solar Energy Society annual meeting and 13th national passive solar conference; Cambridge, MA, USA (18 Jun 1988).

Detailed state-of-the-art building energy simulation models from nations participating in International Energy Agency (IEA) Task VIII are used to develop a quantitative procedure to evaluate more simplified design tools. Simulations are performed with the detailed models on a series of cases that progress systematically from the extremely simple to the relatively realistic. Output values for the cases, such as annual loads, annual maximum and minimum temperatures, and peak loads, are used to set target ranges with which the results from more simplified design tools can be compared. The more realistic cases, although geometrically simple, test the ability of the design tools to model such combined effects as thermal mass, direct gain windows, overhangs, internally generated heat, and dead-band and set-back thermostat control strategies. 5 refs., 9 figs., 4 tabs.

46736 **(SU/ME—1981) Research needs on carbon dioxide and air treatment relating to air quality and ventilation.** Green, G.H. (Saskatchewan Univ., Saskatoon (Canada). Dept. of Mechanical Engineering). 1981. 24p. (CE—01691). CANMET/TID, Energy, Mines and Resources Canada, 555 Booth St., Ottawa, Ont., Canada K1A 0G1; $0.34CAN per page, $3.40 CAN minimum.

Carbon dioxide is a pollutant derived mainly from the human occupancy of buildings. Its rate of release from the human body is well known, and quantity of outdoor air required to maintain a desired level can be calculated. Measurement of carbon dioxide levels in existing or energy efficient buildings are below the threshold limit value. To minimize energy requirements, carbon dioxide concentrations have been used to control outdoor quantities in two buildings. The operation of the control systems proved there is a possible 20 to 40% saving of the energy required to ventilate buildings. Treatment of indoor air to remove indoor generated contaminants can minimize the amount of outdoor air and permit a greater quantity of indoor air to be recirculated. The devices for building air treatment are commercially available but it remains to be seen if they are a more economic solution than the commonly used dilution method. Separate abstracts have been prepared for two papers from this document.

3202 Transportation

REFER ALSO TO CITATION(S) 46760, 47143, 47151

46737 **(N—88-22902) NASA advanced turboprop research and concept validation program.** Whitlow, J.B. Jr.; Sievers, G.K. (National Aeronautics and Space Administration, Cleveland, OH (USA). Lewis Research Center). 1988. 23p. (NASA-TM—100891; E—4129; NAS—1.15:100891; CONF-880887—). NTIS, PC A03/MF A01.

From 32. international technical symposium on optical and opto-electronic applied sciences and engineering; San Diego, CA, USA (14 Aug 1988).

NASA has determined by experimental and analytical effort that use of advanced turboprop propulsion instead of the conventional turbofans in the older narrow-body airline fleet could reduce fuel consumption for this type of aircraft by up to 50 percent. In cooperation with industry, NASA has defined and implemented an Advanced Turboprop (ATP) program to develop and validate the technology required for these new high-speed, multibladed, thin, swept propeller concepts. This paper presents an overview of the analysis, model-scale test, and large-scale flight test elements of the program together with preliminary test results, as available.

46738 **(PB—88-201926/XAB) Analytical comparison of the dynamic performance of a European heavy vehicle and a generic US heavy vehicle. Final report, 15 February 1986-30 June 1987.** Gillespie, T.D.; Balderas, L. (Michigan Univ., Ann Arbor (USA). Transportation Research Inst.). Aug 1987. 378p. (UMTRI—87-17). NTIS, PC A17/MF A01.

This report documents a comparative study of the dynamic performance of U.S. and European tractor-semitrailer combinations. The project was accomplished in two phases - measurement of the suspension and inertial properties to those of a typical U.S. tractor-semitrailer in the context of their influence on dynamic performance as determined by simulation with computer models. A number of qualities related to turning behavior were evaluated. The U.S. and European vehicles were both stable and very comparable in turning performance up to 0.3 g lateral acceleration. In the laden condition, the rollover threshold of the European tractor-semitrailer was 9% better than that of the U.S. vehicle due to higher suspension-roll stiffness, and a lower center-of-gravity height. With regard to suspension roll stiffness, the stiffness on the European vehicle was comparable to the highest used on U.S. vehicles (in contrast to the mid-range values assumed for the comparison U.S. vehicle). The lower center of gravity on the European tractor-semitrailer was due to heavier tare weight and lower load capacity. The European tractor-semitrailer exhibited better braking performance than the U.S. vehicle in the conditions evaluated. Higher front-axle braking levels account for the braking advantage. When unladen, the advantage of the European vehicle is largely attributable to use of load-sensing proportioning valves on the tractor and semitrailer, which allow the front brakes to be used more effectively at lightly loaded conditions.

3203 Industry And Agriculture

REFER ALSO TO CITATION(S) 46758

46739 (AFME—83-2335-1) Experimentation of a catalytic incineration process for the gaseous effluents from a thermo-fixing stenter. (Agence Francaise pour la Maitrise de l'Energie, 75 - Paris). 1985. 54p. (In French). NTIS (US Sales Only), PC A04/MF A01. Order Number DE88754212/JAW.

The synthetics thermofixing process is very polluting and energy consuming. Heat exchangers were tested to recover heat energy but were very rapidly clogged with tars. In order to avoid fouling, it is possible to purify the effluent air without cooling it through a catalytic combustion. The optimal conditions for the catalytic incineration of the pollutants are examined. The tar removal rate reaches 90 percent and the payback period is around one year.

46740 (AFME—1405) Energy crisis and economical development. (Agence Francaise pour la Maitrise de l'Energie, 75 - Paris). 1985. 278p. (In French). NTIS (US Sales Only), PC A13/MF A01. Order Number DE88754214/JAW.

A study concerning the energy problems in rural areas (in France) have been conducted; energy consumption and production are examined in several cases: space heating (households and livestock building), electrical consumption, milk production and processing, vegetable production (wheat, fruits), transportation to and from working places, periodical buyings (phone call orders, home delivery), domestic wastes, waste water, etc... In each case, different alternative solutions are proposed and evaluated various energy conservation and economical development scenarii are compared for the present time conditions.

46741 (DOE/CE/15265—T1) A method of processing biodegradable organic materials: Final report. (Biodynamic Systems, Inc., Horseheads, NY (USA)). 6 Jun 1988. Contract FG01-86CE15265. 22p. NTIS, PC A03/MF A01; 1; GPO Dep. Order Number DE88013641/JAW.

Leprino Food's cheese plant (Waverly, NY) produces wastes, and a pilot plant was constructed for producing fuel gas from this. The pilot plant studies were terminated on December 23, 1987, after 14 months of operation. Numerous problems were identified. Solutions to most of the problems have been found. The effects of carbon dioxide were studied.

46742 (DOE/CE/40772—T3) The production of chemicals from food processing wastes using a novel fermenter separator: Annual report, October 1986-October 1987. (Purdue Univ., Lafayette, IN (USA). Dept. of Agricultural Engineering). May 1988. Contract FG02-85CE40772. 18p. NTIS, PC A12/MF A01; 1; GPO Dep. Order Number DE88011556/JAW.

Fermentation costs (which increase with higher product concentration) traditionally must be balanced against product recovery costs (which decrease with product concentration). A novel reactor-separator process has been developed at Purdue University to minimize product inhibition of fermentation rates. This has been shown to exhibit very high productivities - simultaneously producing and removing a inhibitory product while maintaining a high viable cell concentration in the reactor. The objective of this study is to develop an energy efficient and economical process to convert food wastes to usable chemicals. Work is divided into two major efforts (a) an applied phase which involves design and building a whey to ethanol process as well as process design and optimization and (b) a basic phase which involves investigating alternative fermentation systems and fundamental research on immobilized cell reactor systems. Accomplishments are discussed. 116 refs., 80 figs., 22 tabs.

46743 (DOE/ID/12296—2) High temperature burner-duct-recuperator system evaluation: Second annual report, October 1982–September 1983. Snyder, J. E. (Babcock and Wilcox Co., Lynchburg, VA (USA). Research and Development Div.). Feb 1986. Contract FC07-81ID12296. 308p. NTIS, PC A14/MF A01; 1; GPO Dep. Order Number DE88011186/JAW.

Activities in the second year of a project to develop a high-temperature burner-duct-recuperator are reported. The recuperator is designed to operate in high temperature flue gas streams that contain contaminants and delivers 2000{degree}F preheat air to the combustion system of a steel mill soaking pit. A prototype recuperator was constructed and evaluated. Analysis thermal and fluid flow, flow induced vibration, stress, and materials test data were obtained. Final recuperator system design modifications were made, based on the prototype results, and system fabrication was initiated. Other activities included the development of a high temperature burner, completion of a preliminary economic analysis, and host site preparation.

46744 (DOE/ID/12608—2-Vol.1) Design and control of energy efficient drying processes with specific reference to foods: Volume 1, Literature review: Final report, September 23, 1985 to April 23, 1987. Franzen, K.; Liang, H.; Litchfield, B.; Murakami, E.; Nichols, C.; Waananen, K.; Miles, G.; Okos, M. (Purdue Univ., Lafayette, IN (USA)). Apr 1987. Contract FG07-85ID12608. 142p. NTIS, PC A07/MF A01; 1; GPO Dep. Order Number DE88008725/JAW.

A literature review has been completed and pertinent data from previous food drying studies, information on available and developing sensors for control and monitoring of dryers, production rates and values of various food products has been obtained. This information was used to select the food products to be studied. The areas reviewed in detail include (a) Fundamental Drying Studies, (b) Quality of Foods, (c) Viscoelastic Properties of Grains and Food, (d) Thermal Properties of Porous Foods, (e) Energy Efficient Dryer Designs and (f) Density Independent Moisture Measurement.

46745 (ENEA-RT-FARE—87-7) Desalination plants: Technical information, solar energy. Massa Gallucci, M. (ENEA, Rome (Italy)). Nov 1987. 78p. (In Italian). NTIS (US Sales Only), PC A05/MF A01. Order Number DE88754227/JAW.

The scope of this study is to provide general and technical information concerning the processes and related technologies of desalination. This information provides a comparison among the various plants available on the market and takes into account operating conditions and solar energy options.

46746 (ENEA-RT-FARE—87-10) Energy use and environmental protection in the textile industry: General aspects and a specific example. Tomassetti, G.; Bardelli, E. (ENEA, Rome (Italy)). Dec 1987. 25p. (In Italian). NTIS (US Sales Only), PC A03. Order Number DE88754240/JAW.

Energy saving and environmental protection may work together in a modern industrial context. In the texile district of Busto Arsizio, ENEA (Italian Commission for Nuclear and Alternative Energy Sources) has qualified a new system which recovers energy from the flue gas of an existing boiler operating with heavy oil. The flue gas is then washed with the water of the liquid discharge basin, which, due its basic composition, reacts with the sulfur oxide of the flue gas. The report presents the economical technical and normative parameters of the plant.

46747 (ENEA-RT-FARE—88-2) Anaerobic technologies in organic waste treatment with energy production. ENEA's activities. De Poli, F.; Gamboni, M.; Tilche, A. (ENEA, Rome (Italy)). Mar 1988. 16p. (In Italian). (CONF-8709312—1). NTIS (US Sales Only), PC A03/MF A01. Order Number DE88754239/JAW.

From Convegno internazionale bioenergie e biotechnologie; Carvia, Italy (17 Sep 1987).

Anaerobic processes can be utilized both for organic waste degradation and chemicals-energy production. The spreading anaer-

obic technologies in Italy are related to the traditional Completely Stirred Tank Reactor (CSTR), but promising developments are evolving in the advanced anaerobic technology field, for example - carrier-reactors, UASB and ABR reactors. The high potentiality and versatility of these systems are due to the possibility of operating with a variable contest of organic matter (from the lowest COD values of domestic wastewaters, up to the highest ones found in agro-industry wastewaters) and at temperatures below 20 degrees centigrade. The Organic Wastes Project of ENEA's (Italian Commission for Nuclear and Alternative Energy Sources) FARE Department involves several research activities on advanced anaerobic bioreactors. Research agreements are being drawn up with public and private institutions. The main activities are studies on: biofilm reactors (DSFF, fluidized bed reactors, anaerobic filter reactors), non-carrier reactors (UASB and ABR), hybrid bioreactors, and process microbiology. In this report, the early results of on-going research and development programs are reported.

46748 (EPRI-EM—5912) Glass industry scoping study: Final report. Greene, C.R.; Torrey, J.M. (Electric Power Research Inst., Palo Alto, CA (USA); Science Applications International Corp., Los Altos, CA (USA)). Jul 1988. 113p. Unlimited audience, publicly available. Research Reports Center, Box 50490, Palo Alto, CA 94303. Order Number TI88014501/JAW.

This study of the glass industry is designed to assist electric utility representatives in understanding the industry, glass making processes and the competitive economic factors affecting fuel choice. To achieve this objective, the results are presented in a format of economic assessments. This quantifies the cost elements associated with each segment of manufacturing and differentiates between electricity and natural gas processes for flat glass, container glass, and fiberglass. 31 refs., 7 figs., 40 tabs.

46749 (GAO/RCED—88-44) Superfund: Extent of nation's potential hazardous waste problem still unknown. (General Accounting Office, Washington, DC (USA). Resources, Community and Economic Development Div.). 1987. 38p. US General Accounting Office, PO Box 6015, Gaithersburg, MD 20877.

By 1985, more than 20,000 hazardous waste sites in the United States had been reported to the Environmental Protection Agency, up from 9,500 in 1985. Even so, EPA did not have a complete inventory of these sites and many more remained to be identified and reported before EPA could assess the full extent of the nation's hazardous waste problem. GAO estimates that now as many as 425,000 sites may need to be evaluated but EPA continues to give low priority to helping states identify and inventory new sites. Federal leadership, guidance, and money has been generally nonexistent and as a result, state site identification programs vary considerably. Further, despite GAO's past recommendations, EPA has done little to improve reporting of known sites. EPA must ensure that reasonable efforts are being made to uncover, inventory, and assess potential new sites.

46750 (GAO/RCED—88-48) Hazardous waste: Corrective action cleanups will take years to complete. (General Accounting Office, Washington, DC (USA). Resources, Community and Economic Development Div.). 1987. 42p. US General Accounting Office, PO Box 6015, Gaithersburg, MD 20877.

Years of poor management practices engaged in by many facilities that are covered by the Resource Conservation and Recovery Act of 1976 and that treat, store, or dispose of materials containing hazardous chemical wastes have caused toxic chemicals to seep into the nation's groundwater and surface waters and to contaminate the land and the air.

46751 (GAO/RCED—88-62) Environmental funding: DOE needs to better identify funds for hazardous waste compliance. (General Accounting Office, Washington, DC (USA). Resources, Community and Economic Development Div.). 1987. 11p. US General Accounting Office, PO Box 6015, Gaithersburg, MD 20877.

The Department of Energy, which has significant environmental problems at its facilities, may not be providing sufficient funds for bringing the facilities into compliance with the Resource Conservation and Recovery Act of 1976 and with the Comprehensive Environmental Response Compensation, and Liability Act of 1980, two comprehensive waste management statues. Funds for RCRA and CERCLA are commingled within money allotted for DOE defense operations and are not readily distinguishable. DOE will be separately budgeting and accounting for some of the dollars, but it needs to do more because its efforts will not identify funding for a major portion of compliance activities.

46752 (GRI—88/0051) US industrial process heating energy consumption: 1985. McDermott, H.; Chapman, M.A. (Gas Research Inst., Chicago, IL (USA); Hagler, Bailly and Co., Washington, DC (USA)). Feb 1988. 215p. NTIS, PC A10/MF A01. Order Number TI88013007/JAW.

The objective of this report was to refine and update energy-use estimates for US industrial process heating based on categories defined in an earlier study sponsored by Gas Research Institute (GRI) (Report No. GRI--84/0187. 154 refs., 77 tabs.

46753 (NEI-DK—6) Technical requirements concerning desulfurization products for industrial utilization. Agersted Nielsen, K.; Gram Jeppesen, K. (Danmarks Tekniske Hoejskole, Lyngby. Inst. for Mineralindustri). Apr 1986. 39p. (In Danish). NTIS (US Sales Only), PC A03. Order Number DE88753331/JAW.

A literature search on flue gas desulfurization is made and experiments with desulfurization gypsum from wilhelmshafen are performed. Furthermore a literuature search on hydration of tricalciumaluminate and on the properties of ettringite is made. Experiments are performed to analyse the reactions of tricalciumaluminate with calcium sulfite hennihydrate. The effects on normal texture, setting time, strength development, and sulfite oxidation by replacing up to the half of an addition of 20% fly ash to rapid cement by ash containing desulfurization product are analysed. The utilization of plasticizer has been tested with good result. To find out the possible effect of sulfite containing materials as decelerator mortar bars are casted of pulverized bricks decelerated with gypsum and/or sulfite. A mixing method is found which seems to have the effect that sulfite materials can react as well by mixing in cement as by decelerating bricks. (LN). EFP-85; 43 refs.

46754 (ORNL—6426) Testing to determine chemical stability, handling characteristics, and reactivity of energetic-fuel mixtures: Final report. Lackey, M.E. (comp.). (Oak Ridge National Lab., TN (USA)). Apr 1988. Contract AC05-84OR21400. 92p. (AMXTH-TE-CR—87132). NTIS, PC A05/MF A01; 1; GPO Dep. Order Number DE88013339/JAW.

The US Army generates approximately 2.5 million pounds of waste explosives each year as a result of explosives production and the loading of ordnance. In addition, the US Army currently stores >200,000 tons of obsolete munitions. The current alternative to storage is open-air burning, open-air detonation, or incineration. The US Army Toxic and Hazardous Materials Agency is currently developing methods and procedures for the utilization of energetic materials blended with fuel oil as supplemental fuel in Army industrial combustors. A series of tests were conducted to evaluate the chemical compatibility, reactivity, and handling characteristics of energetic-fuel mixtures. The energetics studied were TNT, RDX, and Composition B. Results indicated that under specific conditions of energetic content, energetic/fuel oil preparation, and system design, energetic/fuel oil mixtures can successfully be used as supplemental fuel in Army industrial combustors. 9 refs., 2 figs., 8 tabs.

46755 (SJF-Beretning—37) Energy consumption and labour demands in direct sowing and traditional soil treatment. Nielsen, V. (Statens Jordbrugstekniske Forsoeg, Horsens (Denmark). Afd. for Driftsteknik og Energi). Nov 1987. 35p. (In Danish). NTIS (US Sales Only), PC A03/MF A01. Order Number DE88754088/JAW.

The energy consumption can be considerably reduced by avoiding soil treatment and instead using a special sowing machine for direct drilling. When growing cereal and rape the fuel consumption for traditional soil treatment is 35-40 litres per ha, and for

direct drilling without soil treatment the fuel consumption is 8-11 litres per ha. Thus, it is possible to save 70-80% of the fuel consumption by changing the method of soil treatment. What costs are concerned the savings are of smaller significance with the present oil prices, as the costs for fuel make up 5-9% of the costs of ordinary soil treatment only, and from 1-2% for direct drilling. (EG).

3206 Municipalities And Community Systems

REFER ALSO TO CITATION(S) 46478, 46747, 46750, 46751

46756 (DOE/CE/30835—T1) MSW [municipal solid waste] emissions and characterization research and destruction of aromatics by hydrogen atoms: Final report. Domalski, E.S.; Churney, K.L.; Ledford, A.E. Jr.; Bruce, S.S.; Buckley, T.J.; Tsang, W. (National Bureau of Standards, Washington, DC (USA). Center for Chemical Physics). Jun 1988. Contract AI01-85CE30835. 59p. NTIS, PC A04/MF A01; 1; GPO Dep. Order Number DE88013488/JAW.

A multi-kilogram capacity flow calorimeter was used in combustion measurements on municipal solid waste (MSW) and refuse-derived fuel (RDF). Cellulose (with and without sand), and MSW doped with PVC were combusted. Gas chromatography were used to study the combustion products. Chlorine mass balance experiments were conducted. Finally, the destruction of chlorinated aromatics by hydrogen atoms was studied. (DLC)

46757 (EMR—8303) RTAC's new guide for the design of roadway lighting. Smallwood, G.E. (Department of Energy, Mines and Resources, Ottawa, Ontario (Canada)). Mar 1983. 38p. (CE—01759). CANMET/TID, Energy, Mines and Resources Canada, 555 Booth St., Ottawa, Ont., Canada K1A 0G1; $0.34CAN per page, $3.40 CAN minimum.

This paper presents a review of a roadway lighting design guide produced under Transport Canada's energy conservation program. The purpose of the guide is to give state of the art methods of roadway lighting design which would optimize systems in view of energy efficiency yet would be reliably designed for traffic safety. The standards used in the guide are largely based on USA standards, with alterations to reflect Canadian experience. These alterations include a decrease in emphasis on major criminal activity and recommended treatments to roads in northerly latitudes which remain snow-packed in winter. The guide includes recommendations on equipment selection and range, mounting heights, safety of pole types and locations, system planning and retrofitting, rating lighting to roadway length and traffic volume, and selection of priorities. Criteria for equipment selection are discussed including light losses, luminance, glare, visibility, and pavement reflectance. The basic design procedure is outlined. Using the procedure involves selecting the three best systems and comparing them in a standard format consisting of annual costs and energy usage per km of roadway. Calculation of certain factors can be done by computer, and the guide includes relevant information on accessing the programs. This report includes examples of printouts using several of the programs. It is concluded that the guide includes sufficient information to enable those responsible for roadway lighting to achieve systems combining optimum efficiency and traffic safety. 5 refs., 22 figs., 6 tabs.

46758 (NEI-DK—83) Decentral combined power and heat plants and wind power in Eastern Denmark. An analysis of the potential and the consequences of increasing decentral combined power and heat plants and windpower in the area of Elkraft excl. Bornholm. Pedersen, S.L. (Danmarks Tekniske Hoejskole, Lyngby. Fysisk Lab. 3). Sep 1987. 353p. (In Danish). NTIS (US Sales Only), PC A16. Order Number DE88754081/JAW.

The thesis is concerned with investigating the technical and economic possibilities as well as the planning prospects for local combined heat and power (CHP) plants and wind power integrated into a large electrical grid. Eastern Denmark, supplied by the Elkraft Power Company, and representing roughly half of the Danish energy consumption, was chosen. The technical description divides the CHP-plants into two main catagories. The first is called peak-power CHP plants. These plants are characterized by low power production in a number of night hours - even during the winter, when the local heat demand is high. The plants simply consist of a gas engine or steam turbine driven CHP unit combined with a short-term heat storage. the second catagory is the so-called LOCUS systems consisting of a gas engine or steam turbine unit combined with a heat pump, a wind generator and two short-term heat storages. The heat pump makes it pussible for a LOCUS system to have low or negative power production during the nights. All types of local CHP plants are computer simulated over a period of one year in order to determine an energy balance. These energy balances are combined with the above-mentioned heat market into two scenarios for the future power system with a total CHP power production of 17-27% of present electricity demand - excluding wind power. The thesis concludes with an economic analysis. The different types of CHP plants are compared to local district heating and centralized coal-based power production with respect to economic impact on the whole energy system. The analysis shows, that whether or not the CHP plants are competitive, is largely a question of fuel prices, the relevant fuels being coal, natural gas and the fuel of the local CHP plant, which may be natural gas, straw or city refuse. With current low fuel prices, only a few CHP plants are competitive. Similar conclusions are reached for wind power plants. (SM).

3209 Education And Public Relations

REFER ALSO TO CITATION(S) 46727

33 ADVANCED AUTOMOTIVE PROPULSION SYSTEMS

3301 Internal Combustion Engines

REFER ALSO TO CITATION(S) 46738

3302 External Combustion Engines

REFER ALSO TO CITATION(S) 47219

46759 Two-dimensional analysis of one-row plate fin and tube heat exchanger. Huang, S.C. (Mechanical Technology Inc., Latham, NY (US)). pp 69-76 of Fluid flow and heat transfer in reciprocating machinery. Morel, T.; Dudenhoefer, J.E.; Uzkan, T.; Singh, P.J. New York, NY; American Society of Mechanical Engineers (1987). (CONF-871234—).

From ASME winter meeting; Boston, MA, USA (13 Dec 1987).

This paper outlines a two-dimensional analysis of the heat transfer of one-row plate fin and tube heat exchangers. The work is motivated by the high-temperature applications in the finned heater design of Stirling engines. While the efficiency of Stirling engines can be improved by raising the heater temperature, the fin material strength at elevated temperatures becomes a limiting factor. The reliable prediction of local fin temperatures, in addition to heat transfer rate, becomes important. In the present study, the two dimensional heat conduction in the fin and in the tube is coupled with the convective heat transfer of the gases both inside and outside the tube. The temperature of the fin and the fin-side gas are numerically solved by the finite difference method. The temperature of the tube is solved analytically in closed form. The heat transfer rate is matched at the fin-tube interface with the inclusion of thermal contact resistance. The heat transfer coefficient between the fin and the gas is a function of position and is based on a correlation derived from the entrance flow between two parallel plates. The calculated results are compared with the test results for Stirling engine heaters, and the agreement is very good.

3308 Alternative Fuels

46760 (LBL—24736) Alternative fuels assessment: The international experience. Sathaye, J.; Atkinson, B.; Meyers, S. (Lawrence Berkeley Lab., CA (USA)). Mar 1988. Contract AC03-76SF00098. 41p. NTIS, PC A03/MF A01; 1; GPO Dep. Order Number DE88014039/JAW.

As part of this analysis, Lawrence Berkeley Laboratory (LBL) has conducted a review of the experience with alternative transport fuels outside the US. The purpose of this review is to better understand what kinds of policies and programs other countries have instituted, and what the response by consumers and the private sector has been. While the experience in other countries grows out of their unique resource, economic, and institutional conditions, it is possible to draw lessons that are useful for evaluating options to develop a flexible-fuel transportation system in the US. The programs of other countries also affect US policy and planning related to alternative fuel supplies and vehicle and conversion technology. 4 figs., 7 tabs.

36 MATERIALS

46761 (DOE/ER/01198—T14) Materials Research Laboratory: Renewal proposal for the extension in time and funds. (Illinois Univ., Urbana (USA). Materials Research Lab.). Mar 1988. Contract AC02-76ER01198. 639p. NTIS, PC A99/MF A01; 1; GPO Dep. Order Number DE88013776/JAW.

An overview of research in materials science at the University of Illinois is presented. Research programs include the areas of superconductivity, semiconductor materials, solid state physics, and research on mechanical properties, physical properties, thin films and microstructure. Individual projects are processed separately for the data bases. (CBS)

46762 (DOE/ER/45096—3) [Stability of amorphous metal films on semiconductor substrates]. Perepezko, J.H.; Wiley, J.D. (Wisconsin Univ., Madison (USA). Dept. of Metallurgical and Mineral Engineering). 1987. Contract FG02-84ER45096. 12p. NTIS, PC A03/MF A01; 1; GPO Dep. Order Number DE88012567/JAW.

In the culmination of work which began in June 1984, goals of this research have been as follows: Investigation of the stability of amorphous alloys films during diffusion and interdiffusion treatments. The atomic transport measurements will be conducted by a combination of RBS and AES techniques as explained in earlier reports. X-ray diffraction and transmission electron microscopy will be used for structural examination. Investigation of the electrical behavior of amorphous metal/semiconductor contacts, including both the interfacial electrical (Schottky barrier and Ohmic) behavior and the stability of the amorphous metallization against current-induced degradation by electromigration. Fundamental studies of the electromigration process itself will be conducted in this broader context. Examination of structural relaxation during post-depression annealing.

46763 (LBL-PUB—642) Center for Advanced Materials research notes: Volume 1, No. 1. (Lawrence Berkeley Lab., CA (USA)). Apr 1987. Contract AC03-76SF00098. 10p. NTIS, PC A03/MF A01; 1; GPO Dep. Order Number DE88013590/JAW.

Research Notes is published three times each year by the Center for Advanced Materials at Lawrence Berkeley Laboratory. It is distributed widely in the US materials-dependent industrial community and is one mechanism by which recent research results at the Center are communicated to that audience. More detailed information about this and related research can be found in the references cited on each page. Brief descriptions are given of the following projects: Asymmetry in graphite, polymer processing, surface science and catalysis, electronic materials (GaAs), enzymatic synthesis of materials, structural materials (Li-Al) and cryogenics, ceramic and metal interfaces (vapor deposited Cr films), and industry participation. The CAM scientists involved can also be reached at the telephone numbers listed. 1 fig.

46764 (MLM—3497(OP)) Glass-ceramic fusion with a CO_2 laser. DeVore, L.J.; Mohler, J.H. (Monsanto Research Corp., Miamisburg, OH (USA). Mound). 1988. Contract AC04-76DP00053. 7p. (CONF-8804159—1). NTIS, PC A02/MF A01; 1; GPO Dep. Order Number DE88012871/JAW.

From Medical and material processing applications of various types of lasers; Cincinnati, OH, USA (21 Apr 1988).

Glass-to-ceramic sealing is possible with CO_2 laser. Wetting of the ceramic by the glass is an important factor. It is necessary to either pre-coat the substrate with the sealing glass, or allow the substrate to remain hot in the sealing region for sufficient time for good wetting. Glass composition, substrate thickness, laser beam power density and scan rate all must be controlled to optimize sealing. Equal heating of the two glass-ceramic interfaces is also critical to uniform seal formation. 2 refs., 6 figs.

3601 Metals And Alloys

REFER ALSO TO CITATION(S) 46375, 46375, 46378, 46502, 46532, 46591, 46592, 46602, 46619, 46672, 46672, 47077, 47083, 47111, 47145, 47276, 47683, 47743, 47744, 47752, 47807, 47808, 47856, 47877, 47880, 47982, 47995

46765 (AD-A—192450/5/XAB) Laser cladding of Ni-Cr-Al-Hf on inconel 718 for improved high-temperature oxidation resistance. Singh, J.; Nagarathnam, K.; Mazumder, J. (Illinois Univ., Urbana (USA). Laser Aided Materials Processing Lab.). 3 Aug 1987. 8p. (LAMP-AF—04). NTIS, PC A02/MF A01.

Pub. in High Temperature Technology, Vol. 5, No. 3, 131-138(Aug 1987).

In-situ Ni-Cr-Al-Hf alloy was developed by laser surface cladding with a mixed-powder feed for improved high-temperature oxidation resistance. Oxidation-resistant materials for operation at elevated temperatures must satisfy two requirements: diffusion through the oxide scale must occur at the lowest possible rate, and the oxide scale must resist spallation. Formation of an Al_2O_3 protective scale fulfills the former requirement but its adherence is poor. A reactive metal such as Hf is added to improve adhesion. A 10-kW CO_2 laser was used for laser cladding. Optical, SEM and STEM microanalysis techniques were employed to characterize the different phases produced during the cladding process. Microstructural studies showed a high degree of grain refinement, increased solid solubility of Hf in the matrix and the formation of Hf-rich precipitates. A thermogravimetric analysis was carried out to determine the oxidation properties of these clad alloys with an extended solid solution of Hf. Considerable improvement over the base metal was observed. This paper discusses microstructural development in this laser-clad alloy and its effect on oxidation.

46766 (ANL/FE—88-2) Methodologies for prediction of metal oxidation-vaporization-erosion. Liu, Y.Y.; Natesan, K. (Argonne National Lab., IL (USA)). Dec 1987. Contract W-31109-ENG-38. 113p. NTIS, PC A06/MF A01; 1; GPO Dep. Order Number DE88013623/JAW.

High-temperature oxidation (or more generally, corrosion) and solid-particle erosion both involve the action of the environment on the near-surface region of materials. The interaction in oxidation/corrosion is primarily chemical and physical; that of erosion, which involves the transfer of kinetic energy of the erodent particles to the target materials, is principally mechanical. Sustained oxidation and erosion, acting alone or in combination, can cause serious damage to materials and are the major modes of degradation for components used in a variety of fossil energy systems. Numerous studies have been conducted in the past on oxidation, as well as on solid-particle erosion, of metals and alloys. However, very few studies have examined the fundamental aspects of oxidation-erosion, especially in regimes where the two modes act synergistically. This report documents recently developed models for the synergistic interaction of oxidation and erosion of metals and alloys. The models consider three competing processes: oxide scale thickening via growth, thinning via vaporization, and erosion. It has been demonstrated that not only do the models numerically reproduce the general features of oxidation-erosion observed in the few reported experiments on pure metals and alloys, but they also provide con-

siderable insight into the conditions under which one mode (oxidation or erosion) can become dominant over the other. The approach enables the identification of oxidation- or erosion-dominant regimes for future experiments, and aids in the prediction of metal consumption as a function of exposure conditions. 69 refs., 40 figs., 7 tabs.

46767 (CEGB-TPRD/B—0918/R87) X-ray photoelectron spectroscopy of the uranium/oxygen system: Part 13. The behaviour of uranium metal in hydrogen/water vapour atmospheres. Allen, G.C.; Stevens, J.C.H. (Central Electricity Generating Board, Berkeley (UK). Berkeley Nuclear Labs.). Feb 1987. 18p. NTIS (US Sales Only), PC A03/MF A01. Order Number DE88754263/JAW.

The reaction between commercial H/sub 2/ and uranium metal leads to the formation of UO/sub 2/ due to traces of water vapour or oxygen. When extremely pure H/sub 2/ is used uranium hydride may be formed but, even with 99.9999% H/sub 2/, uranium dioxide forms preferentially. The present work identifies the presence of UH/sub 3/ in the X-ray photoelectron spectrum of a uranium sample which has been exposed to ~ 5 mbar H/sub 2/ at ~ 200/sup 0/C for 1 hour. This spectrum indicates that the hydride possesses a high degree of covalency, since the oxidation state of uranium in UH/sub 3/ appears to be ~ 1.4. (U.K.).

46768 (CEGB-TPRD/B—0952/R87) Corrosion studies of thermally sensitised AGR fuel element brace in pH7 and pH9.2 borate solutions. Tyfield, S.P.; Smith, C.A. (Central Electricity Generating Board, Berkeley (UK). Berkeley Nuclear Labs.). Apr 1987. 53p. NTIS (US Sales Only), PC A04/MF A01. Order Number DE88754266/JAW.

Brace and cladding of AGR fuel elements sensitised in reactor are susceptible to intergranular and crevice corrosion, which may initiate in the pH7 borate pond storage environment of CEGB/SSEB stations. This report considers the benefit in corrosion control that is provided by raising the pond solution pH to 9.2, whilst maintaining the boron level at 1250 gm/sup -3/. The greater corrosion protection provided by pH9.2 solution compared to the pH7 borate solution is demonstrated by a series of tests with non-active laboratory sensitised brace samples exposed to solutions dosed with chloride or sulphate in order to promote localised corrosion. The corrosion tests undertaken consisted of 5000 hour immersions at 32/sup 0/C and shorter term electrochemically monitored experiments (rest potential, impedance, anodic current) generally conducted at 22/sup 0/C. The pH9.2 solution effectively inhibited the initiation of crevice and intergranular corrosion in the presence of low levels of chloride and sulphate, whereas the pH7 solution did not always do so. However, the pH9.2 solution, dosed with 40 gm/sup -3/ chloride, failed to suppress fully crevice corrosion initiated in unborated 40 gm/sup -3/ chloride solution at 22/sup 0/C. Fluoride is not deleterious at low levels ~ 10 gm/sup -3/ in the borate solutions. The significant improvement in corrosion control demonstrated for the change from pH7 to pH9.2 borate solution on laboratory sensitised brace samples should ideally be confirmed using complete irradiated AGR fuel elements. (U.K.).

46769 (CEGB-TPRD/B—0955/R87) Reaction of uranium with moist hydrogen. Pearce, R.J.; Kay, P. (Central Electricity Generating Board, Berkeley (UK). Berkeley Nuclear Labs.). Oct 1987. 31p. NTIS (US Sales Only), PC A03/MF A01. Order Number DE88754267/JAW.

The reaction of uranium in moist hydrogen at a total pressure of 101 kPa over the temperature range 105/sup 0/-200/sup 0/C and water vapour pressures in the range 5-100 kPa has been examined in a limited thermogravimetric study. It has been shown that initially there is a period during which only linear kinetics are observed with a rate similar to that exhibited in similarly moist argon, i.e. hydrogen has no apparent effect on the reaction. At water vapour pressures of and above 49 kPa, corresponding to hydrogen:water vapour pressure ratios in the range 1:1 to 1:100, over the exposure times studied (not > 20h) only such linear kinetics are observed. Below this water vapour pressure and after an initial period of linear kinetics a continuously increasing reaction rate was observed in some instances resulting from rapid attach on localised areas. The localised reaction rates were approximately 2-3 orders of magnitude faster than the original linear reaction kinetics and the interaction rates in either moist argon or moist air. Comparison with a single experiment carried out at 150/sup 0/C indicated that breakaway rates were approaching that in dry hydrogen. During breakaway attack there was a significant increase in the relative amounts of uranium hydride formed. The duration of the linear kinetics phase was extended by pre-oxidation of the uranium surface, decreasing temperature at a constant water vapour pressure, or increasing water vapour pressure (or water vapour: hydrogen pressure ratio) at a constant temperature.

46770 (CEGB-TPRD/B—1016/R87) Role of tin in the irradiation embrittlement of PWR pressure vessel steels. Jones, R.B.; Buswell, J.T. (Central Electricity Generating Board, Berkeley (UK). Berkeley Nuclear Labs.). Dec 1987. 23p. (PWR/RCC/MWG/P—87-/70M). NTIS (US Sales Only), PC A03/MF A01. Order Number DE88754276/JAW.

An analysis has been performed of the influence of up to 0.020 w/o tin on the change in mechanical properties of PWR pressure vessel steels following MTR irradiation at 288/sup 0/C to 2.5-5.0 x 10/sup 19/ n center dot cm/sup -2/ (E > 1.0 MeV). The properties examined were the impact transition temperature shifts (ΔT) and hardness changes (ΔHsub(v)). The increment in irradiation embrittlement due to tin (ΔT/ΔSn) increased from 800/sup 0/C/1 w/o Sn to 2100/sup 0/C/1 w/o Sn as the residual impurity levels in the steel rose from 0.02 w/o Cu, 0.008 w/o P to 0.09 w/o Cu, 0.018 w/o P respectively. Further increases in the residual copper content from 0.10 to 0.30 w/o, or increases to 0.028 w/o phosphorus, caused ΔT/ΔSn to fall eventually to zero. Hardness changes due to tin additions (ΔHsub(v)/ΔSn) were a maximum in the purest steels but fell progressively to low values as the residual copper and phosphorus levels were raised. Similar hardening and embrittlement effects due to additions of tin have been found in a 3.5%NiCr steel, irradiated to ~ 10/sup 19/ n center dot cm/sup -2/ at 130/sup 0/C; this steel failed with an intergranular-ductile fracture transition. Interpretations of the role of tin wholly in terms of a hardening process or a combined hardening and grain boundary embrittlement process were unsuccessful and some additional experiments have been suggested for clarification. The practical implications involve the current CEGB PWR vessel steel specification; the permitted level of tin (0.010 w/o) is estimated to produce an increment in ΔT = 10/sup 0/C at the end-of-life dose for the vessel belt-line forging. This represents ~ 20% of the maximum ΔT value anticipated.

46771 (CEGB-TPRD/B—1067/R88) Role of hardness and microstructure in high temperature pitting in the impact wear of 9Cr boiler material. Part 1. Impact wear assessment. Morri, J. (Central Electricity Generating Board, Berkeley (UK). Berkeley Nuclear Labs.). Nov 1987. 25p. NTIS (US Sales Only), PC A03/MF A01. Order Number DE88754280/JAW.

This report describes impact wear experiments on 9Cr1Mo finned boiler tube specimens in 3 different heat treated forms. The objective of the tests was to establish whether a high temperature, high wear rate, pitting form of wear was dependent upon the residual microstructure and hardness. Although a x2 reduction in specific wear rate was achieved for the martensitic structure, the pitting characteristic remained. It is concluded that modifying the as-received 9Cr microstructure has not suppressed the high temperature severe form of wear.

46772 (CEGB-TPRD/L—3180/R87) Behaviour of Type 316 steel in acidic sulphate solutions at 300-350/sup 0/C. Newman, J.F. (Central Electricity Research Labs., Leatherhead (UK)). Nov 1987. 50p. NTIS (US Sales Only), PC A03/MF A01. Order Number DE88754281/JAW.

Most cation resin beds in service in CEGB power stations, and particularly those in AGR stations, are regenerated with sulphuric acid. Slippage results in trace levels of sulphate passing into the boilers. Previous work has shown that in once-through boilers, feedwater containing 2 μg kg/sup -1/ of sulphate could concentrate at localized dry-out sites to form solutions having from 0.1 to 7 wt% of solute. It has been shown also that if the sulphate was present in an acidic solution and it were to be in contact with Type

316 austenitic superheater steel, then intergranular corrosion and intergranular cracking could occur. Previous data, including some unreported results, are tabulated and discussed. The current work had two main objectives. The first was to extend the previous investigations to examine a wider range of acidic sulphate concentrations (as indicated by calculations on the concentration of solute in feedwater), the influence of environment pH, and the effect of sensitization of specimens. The second objective was primarily concerned with elucidating the causes of scatter in the results. This involved examining the influence of electrode potential, the ageing characteristics of the environment, and the method of applying stress to the specimens.

46773 **(CONF-880408—33) Impurity-induced changes in interfacial strength and their role in creep fracture.** George, E.P.; Pope, D.P. (Oak Ridge National Lab., TN (USA); Pennsylvania Univ., Philadelphia (USA). Dept. of Materials Science and Engineering). 1988. Contract AC05-84OR21400. 8p. NTIS, PC A02/MF A01; 1; GPO Dep. Order Number DE88013197/JAW.

From Spring meeting of the Materials Research Society; Reno, NV, USA (4 Apr 1988).

Creep cavity nucleation at second phase particles in iron and steel is examined in the light of recent theoretical and experimental results. Theoretical considerations show it to be extremely unlikely that thermal nucleation will occur at Fe_3C, FeO or Al_2O_3 particles, or that athermal nucleation will take place at Fe_3C particles. Consistent with this, it is experimentally found that carbides and oxides almost never nucleate cavities in iron and steel, as long as harmful impurities like sulfur are not present In the presence of segregated impurities like sulfur, oxides do nucleate cavities, but there is insufficient data to determine whether this is because the impurities make thermal or athermal nucleation easier. Finally, sulfides are thought to be nonwetting in iron and steel. As a result, there should be no barrier to thermal nucleation at sulfides, and experiments show that sulfides do nucleate cavities with great ease in iron and steel.

46774 **(CONF-880613—15) Microstructural development of titanium-modified austenitic stainless steel under neutron irradiation in HFIR up to 57 dpa.** Suzuki, M.; Hamada, S.; Maziasz, P.J.; Tanaka, M.P.; Hishinuma, A. (Oak Ridge National Lab., TN (USA)). 1988. Contract AC05-84OR21400. 28p. NTIS, PC A03. Order Number DE88013248/JAW.

From 14. international symposium on effects of radiation on materials; Andover, MA, USA (27 Jun 1988).

The Japanese prime candidate alloy (JPCA), a titanium modified austenitic stainless steel, has shown good performance after irradiation in HFIR up to 34 dpa at 300 C to 600 C, but considerable void swelling develops in solution annealed (SA) JPCA after irradiation 57 dpa at 500 C. However, cold worked (CW) or cold worked and aged (CW+A) JPCA still demonstrates good performance after similar irradiation. Swelling resistance appears to strongly depend on the behavior of fine titanium-rich MC precipitates. This paper describes the microstructural evolution process observed in the JPCA steel during HFIR irradiation. The onset of rapid void swelling was related to MC precipitate dissolution, and the instability of the MC was interpreted in terms of a model involving the build of and effects of a solute segregation zone in the matrix surrounding the precipitate particle. 8 refs., 9 figs., 3 tabs.

46775 **(CONF-880841—5) Crystallization of Zr-Ni metallic glasses.** McKamey, C.G.; Kroeger, D.M.; Easton, D.S.; Horton, J.A. (Oak Ridge National Lab., TN (USA)). 1988. Contract AC05-84OR21400. 3p. NTIS, PC A02/MF A01; 1; GPO Dep. Order Number DE88007481/JAW.

From MAS/EMSA microbeam analysis conference; Milwaukee, WI, USA (7 Aug 1988).

The results of our study of the crystallization processes of Zr-Ni metallic glasses between 55 and 70% Zr, combined with the results of low-temperature specific heat measurements, indicate that the glass structures of these alloys are characterized by SROs which are similar to, or which promote the formation of, the crystalline phases to which they transform. Glasses of 60 and 66.7% Zr transform rapidly to the metastable and Zr_2Ni phases, respectively, as evidenced by a single sharp DSC exotherm. This indicates that their SROs are similar to the metastable and Zr_2Ni phases, respectively, and that little diffusion in the glass is necessary for crystallization to proceed. However, as-quenched glasses between these compositions (around the eutectic) possess SROs characteristic of both phases. Individual areas of similar SRO, produced by phase separation during the quench from the liquid, must grow together (requiring diffusion of atoms) in order for crystallization to proceed. Evidence for the presence of a metastable phase centered at a composition of 60% Zr, plus the presence of an equilibrium phase at 66.7% Zr (Zr_2Ni), both within 3.5% of the eutectic at approximately 63.5% Zr, lends feasibility to this hypothesis. 5 refs., 2 figs.

46776 **(CONF-880877—1) Ratchetting behavior of type 304 stainless steel at room and elevated temperatures.** Ruggles, M.; Krempl, E. (Oak Ridge National Lab., TN (USA)). 1988. Contract AC05-84OR21400. 22p. NTIS, PC A03/MF A01; 1; GPO Dep. Order Number TI88011864/JAW.

From International seminar on the inelastic behaviour of solids: models and utilization; Besancon Cedex, France (30 Aug 1988).

The zero-to-tension ratchetting behavior was investigated under uniaxial loading at room temperature and at 550, 600 and 650{degree} C. In History I the maximum stress level of ratchetting was equal to the stress reached in a tensile test at one percent strain. For History II the maximum stress level was established as the stress reached after a 2100 s relaxation at one percent strain. Significant ratchetting was observed for History I at room temperature but not at the elevated temperatures. The accumulated ratchet strain increases with decreasing stress rate. Independent of the stress rates used insignificant ratchet strain was observed at room temperature for History II. This observation is explained in the context of the viscoplasticity theory based on overstress by the exhaustion of the viscous contribution to the stress during relaxation. The viscous part of the stress is the driving force for the ratchetting in History I. Strain aging is presumably responsible for the lack of short-time inelastic deformation resulting in a nearly rate-independent behavior at the elevated temperatures. 26 refs., 7 figs., 1 tab.

46777 **(CONF-8710275—3) A small-angle neutron scattering study of decomposition dynamics in Ni/sub 87.5/Si/sub 12.5/.** Polat, S.; Chen, H.; Epperson, J.E. (Argonne National Lab., IL (USA)). Feb 1988. Contract W-31109-ENG-38. 20p. NTIS, PC A03/MF A01; 1; GPO Dep. Order Number DE88011997/JAW.

From International conference on applications and techniques of small angle scattering; Argonne, IL, USA (26 Oct 1987).

The kinetic behavior of precipitation in a supersaturated Ni-12.5 at. % Si alloy single crystal has been studied by the small-angle neutron scattering (SANS) technique to supplement earlier transmission electron microscopy (TEM) and wide-angle x-ray diffraction (XRD) work. The SANS measurements performed at room temperature on quenched specimens subjected to isothermal anneals at 400, 450, 505 and 550{degree}C for various amounts of time have revealed the presence of an interference peak in the scattering function. The particle size, determined according to the Guinier approximation, is found to obey the t/sup 1/3/ coarsening law at long aging times. For short aging times below 500{degree}C, a classical "growth" stage characterized by a parabolic growth rate is noticed before coarsening takes effect--an observation consistent with our previous in-situ XRD work. The activation energy for solute diffusion is determined using the rate constants governing the growth of particle size and the variation of the mean interparticle distance. Results are in good agreement with the values given in the literature. Enhanced diffusion due to quenched-in excess vacancies is observed below 500{degree}C. The dynamical scaling law appears to be followed for the data obtained in the coarsening stage. A disruption of scaling occurs at the point when the particle growth changes from a parabolic rate behavior to a cubic coarsening rate. 8 refs., 5 figs., 2 tabs.

46778 **(CONF-8805164—1) Coble creep, cavity sintering, and cavity growth.** Schneibel, J.H.; Martinez, L. (Oak Ridge National Lab., TN (USA)). 1988. Contract AC05-84OR21400. 13p. NTIS, PC A03/MF A01; 1; GPO Dep. Order Number DE88013846/JAW.

From Symposium on the sintering of advanced ceramics; Cincinnati, OH, USA (1 May 1988).

The close relationships between Coble creep, cavity sintering and cavity growth are discussed. The measurement of size distributions of crack-like cavities is useful for determining grain boundary and surface diffusivities. In nickel aluminide (Ni_3Al) intermetallics the grain boundary diffusivity determined in this manner agrees well with that obtained from Coble creep measurements. A critical comparison of the zero-creep technique and the "zero-growth" technique (critical cavity radius determination) to measure surface free energies is given. 20 refs., 6 figs.

46779 (DOE/ER—45280) The effect of extra Cu on ordering kinetics in thin films of Cu_3Au. Shannon, R.F. Jr.; Harkles, C.R.; Nagler, S.E. (Florida Univ., Gainesville (USA). Dept. of Physics). 1988. Contract FG05-86ER45280. 18p. (CONF-880308—1). NTIS, PC A03/MF A01; GPO Dep. Order Number DE88013974/JAW.

From Meeting of the American Physical Society; New Orleans, LA, USA (21 Mar 1988).

Time-resolved x-ray scattering has been used to study ordering kinetics in sputtered films of Cu_3Au. The samples were annealed at high temperatures, then quenched to fixed temperatures below the order-disorder transition temperature. Domain coarsening observed in stoichiometric films is consistent with curvature driven growth. Domain growth in films of Cu/sub 0.79/Au/sub 0.21/ proceeds much more slowly. The results suggest that the extra copper has the same effect on the ordering kinetics as a diffusive imurity, resulting in domain sizes growing logarithmically with time. 19 refs., 6 figs., 1 tab.

46780 (DOE/ER/01198—T16) Constraints on the growth of metallic superlattices. Flynn, C.P. (Illinois Univ., Urbana (USA)). 1988. Contract AC02-76ER01198. 14p. (MRL—88-0003). NTIS, PC A03/MF A01; 1; GPO Dep. Order Number DE88014633/JAW.

It is shown why the epitaxial growth of high quality metallic superlattices generally requires a growth temperature {approximately}3T/sub m//8 and two components having similar melting temperatures T/sub m/. A general observation of RHEED oscillations from growing metal surfaces at temperatures {approximately}T/sub m//8 is also predicted. 16 refs., 2 figs.

46781 (DOE/ER/01198—T21) Experimental and theoretical study of inclusions during initiation of crevice corrosion. Lott, S.E. (Illinois Univ., Urbana (USA)). 1987. Contract AC02-76ER01198. 179p. NTIS, PC A09/MF A01; 1; GPO Dep. Order Number DE88014635/JAW.

The purpose of this investigation was to determine the initiation mechanism of crevice corrosion on stainless steel in a neutral nickel electrolyte. Kinetic experiments were run on MnS electrodes to understand the depassivation effect of the MnS inclusion on the stainless steel oxide film. The depassivation effect of the species produced at the MnS inclusions in conjunction with the nickel electrolyte led to a proposed mechanism to explain the initiation of breakdown. A mathematical model based on the proposed mechanism was written and incorporated the geometry of the crevice, the MnS surface inclusion density, and the electrochemical potential at the edge of the crevice. The range of validity of the model was tested by comparing the results from the model with stainless steel crevice corrosion experiments. 55 refs., 39 figs., 6 tabs.

46782 (DOE/ER/45158—T2) Experimental and theoretical studies on transport processes in laser welding: Annual technical progress report, August 1, 1987-July 31, 1988. DebRoy, T. (Pennsylvania State Univ., University Park (USA). Office of Sponsored Programs). 12 Jul 1988. Contract FG02-84ER45158. 4p. NTIS, PC A02/MF A01; 1; GPO Dep. Order Number DE88013933/JAW.

Vaporization of alloying elements is a serious problem in the laser welding of many important engineering alloys. Since the available mass transfer correlations are not applicable for credible assessment of the rates of transport of vaporized species in the gas phase, the role of gas phase mass transfer in the overall vaporization of alloying elements was examined by conducting several critical experiments. The rates of transport of alloying elements in the weld pool were determined from numerically computed fluid flow fields. Since the weld pool is surrounded by plasma during laser welding, the role of plasma in the vaporization of alloying elements was physically modeled by allowing molten copper drops to vaporize isothermally both in the presence and absence of plasma. The transport of alloying elements in both liquid and gas phases was found to be rapid and the overall vaporization rates were controlled by the plasma influenced intrinsic vaporization of alloying elements at the weld pool surface.

46783 (DOE/ER/45184—4) The role of grain boundary character in the environmentally-assisted intergranular cracking mechanism of nickel-base alloys: Progress report, August 1, 1987-July 31, 1988. Was, G.S. (Michigan Univ., Ann Arbor (USA). Dept. of Nuclear Engineering). Jul 1988. Contract FG02-85ER45184. 28p. NTIS, PC A03/MF A01; 1; GPO Dep. Order Number DE88014130/JAW.

Grain boundary chemistry and structure of high-purity Inconel 690- type alloys (carbon doped) were studied. Heat treatments were carried out to assess the modified (for alloy 690) DEPLETE code. Chromium, depletion profiles were measured. Grain boundary orientation will be measured using electron channeling. Constant elongation note tests were conducted to evaluate the dependence of IGSCC susceptibility on grain boundary chemistry. Effects of hydrogen on grain boundary fracture was studied as a function of grain boundary structure, temperature and alloy composition (Ni, alloy 600, alloy 690). 16 refs., 6 figs., 9 tabs. (DLC)

46784 (DOE/ER/45280—T1) X-ray scattering studies of non-equilibrium ordering processes: Progress report, November 1, 1987--October 31, 1988. Nagler, S.E. (Florida Univ., Gainesville (USA). Dept. of Physics). Jun 1988. Contract FG05-86ER45280. 23p. NTIS, PC A03/MF A01; 1; GPO Dep. Order Number DE88012908/JAW.

We outline the progress of our project entitled "X-ray Scattering Studies of Non-Equilibrium Ordering Processes." The kinetics of the order-disorder transition in Cu(sub 3)Au has been carefully examined. Experiments on single crystals have verified that there is anisotropic non-equilibrium scaling in the coarsening regime. Measurements on sputtered films of varying stoichiometry have probed the effects of randomness on kinetics. Investigations on Cu (sub 3) Au grown single crystal films have studied the role of dimensionality. Further experiments have begun on the alloy Au 47.5 percent Cd, a super-elastic martensitic system. 5 refs.

46785 (FhG-W—16/87) Calculation of J/sub 1/ and J/sub 2/ using the L- and M integrals. Kienzler, R.; Kordisch, H. (Fraunhofer-Institut fuer Werkstoffmechanik, Freiburg im Breisgau (Germany, F.R.)). Dec 1987. 25p. NTIS (US Sales Only), PC A03/MF A01. Order Number DE88754586/JAW.

Path-independent integrals of linear plane elasticity are treated analytically and numerically. The application of the integrals and their physical significance in terms of energy - release rates are illustrated with a closed-form solution of the hole-dislocation - interaction problem. It is shown that the use of the L and M integrals, besides J/sub 1/ and J/sub 2/, is beneficial to the numerical investigation of cracks under mixed-mode conditions. (orig.) With 3 figs., 1 tab., 30 refs.

46786 (IC—88/43) Radiative effect in change of phase under general differential approximation. Bestman, A.R. (International Centre for Theoretical Physics, Trieste (Italy)). Feb 1988. 10p. NTIS (US Sales Only), PC A02/MF A01. Order Number DE88703841/JAW.

The problem considers the melting of high temperature alloys when radiative heat transfer is important in the liquid phase though negligible in the solid phase. The model is restricted to the study of one-dimensional phase change problem for general differential approximation for radiation and for the optically thin fluid approximation. Comparison with the exact integral formalism reveals an error of about 3%. The problem is important in extension to more general two-dimensional flows where the integral formalism is prohibitively difficult. (author). 9 refs, 2 figs.

46787 (INIS-BR—1157, pp 94) **Study of the internal oxidation kinetic of indium impurities in silver.** Bibiloni, A.G.; Desimoni, J.; Lopes G, A.; Massolo, C.P.; Pasquevich, A.F.; Sanchez, F.H. (La Plata Univ. Nacional (Argentina)). 1981. (In Spanish). NTIS (US Sales Only), PC A06/MF A01. Order Number DE88703560/JAW. (CONF-8109291—).

From 7. Latin American symposium on solid state physics; Gramado, Brazil (14 Sep 1981).

46788 (INIS-BR—1157, pp 98) **Oxidation in pure oxygen of the Zr-85% Al alloy.** Slutzky, R.O.; Garcia, E.A. (Comision Nacional de Energia Atomica, Buenos Aires (Argentina)). 1981. (In Spanish). NTIS (US Sales Only), PC A06/MF A01. Order Number DE88703560/JAW. (CONF-8109291—).

From 7. Latin American symposium on solid state physics; Gramado, Brazil (14 Sep 1981).

46789 (INIS-BR—1157, pp 46) **Effect of Ti in the β-Zr(Fe) stabilization.** Silva, E.G. da; Coelho, J.S.; Mansur, R.A. (Minas Gerais Univ., Belo Horizonte (Brazil). Dept. de Fisica). 1981. (In Portuguese). NTIS (US Sales Only), PC A06/MF A01. Order Number DE88703560/JAW. (CONF-8109291—).

From 7. Latin American symposium on solid state physics; Gramado, Brazil (14 Sep 1981).

46790 (INIS-BR—1157, pp 76) **Study of the Fe-Nb diagram, rich in Nb.** Zelaya B, J.M. (Universidad Mayor de San Andres, La Paz (Bolivia)). 1981. (In Spanish). NTIS (US Sales Only), PC A06/MF A01. Order Number DE88703560/JAW. (CONF-810991—).

From International symposium on present and future status of the anthracycline antibiotics in cancer; New York, NY, USA (16 Sep 1981).

46791 (INIS-BR—1157, pp 96) **Diffusion of Cr/sup 51/ in Zr-Sn alloys.** Nicolai, L.I.; Tendler, R.H. de. (Comision Nacional de Energia Atomica, Buenos Aires (Argentina)). 1981. (In Spanish). NTIS (US Sales Only), PC A06/MF A01. Order Number DE88703560/JAW. (CONF-8109291—).

From 7. Latin American symposium on solid state physics; Gramado, Brazil (14 Sep 1981).

46792 (INIS-BR—1157, pp 74) **Elastic properties of chromium - vanadium alloys near to magnetic transition temperature.** Camargo, P.C. de; Brotzen, F.R. (Sao Carlos Univ. (Brazil); Rice Univ., Houston, TX (USA)). 1981. (In Portuguese). NTIS (US Sales Only), PC A06/MF A01. Order Number DE88703560/JAW. (CONF-8109291—).

From 7. Latin American symposium on solid state physics; Gramado, Brazil (14 Sep 1981).

46793 (INIS-BR—1157, pp 115) **Curved stress relaxation, in Zr Y-4 at 673 K with different thermomechanical treatments.** Povolo, F.; Peszkin, P.N. (Comision Nacional de Energia Atomica, Buenos Aires (Argentina); Comision de Investigaciones Cientificas de la Provincia de Buenos Aires (CIC), La Plata (Argentina)). 1981. (In Spanish). NTIS (US Sales Only), PC A06/MF A01. Order Number DE88703560/JAW. (CONF-8109291—).

From 7. Latin American symposium on solid state physics; Gramado, Brazil (14 Sep 1981).

46794 (INIS-BR—1157, pp 55) **Magnetic behavior of the Ce (Fe/sub 0.8/Al/sub 0.2/)/sub 2/ compound.** Cunha, S.F. da; Franceschini, D.F.; Senoussi, S.; Takeushi, A.Y. (Centro Brasileiro de Pesquisas Fisicas, Rio de Janeiro). 1981. (In Portuguese). NTIS (US Sales Only), PC A06/MF A01. Order Number DE88703560/JAW. (CONF-8109291—).

From 7. Latin American symposium on solid state physics; Gramado, Brazil (14 Sep 1981).

46795 (INIS-BR—1157, pp 56) **Superconducting and magnetic interactions in La/sub 1.2-x/ Eu/sub x/ Mo/sub 6/ S/sub 8/.** Torikachvili, M.S.; Maple, M.B.; Guertin, R.P.; Foner, S. (California Univ., San Diego (USA); Tufts Univ. (USA)). 1981. NTIS (US Sales Only), PC A06/MF A01. Order Number DE88703560/JAW. (CONF-8109291—).

From 7. Latin American symposium on solid state physics; Gramado, Brazil (14 Sep 1981).

46796 (INIS-BR—1157, pp 61) **Remanent magnetization in spin glass.** Oseroff, S. 1981. (In Spanish). NTIS (US Sales Only), PC A06/MF A01. Order Number DE88703560/JAW. (CONF-8109291—).

From 7. Latin American symposium on solid state physics; Gramado, Brazil (14 Sep 1981).

46797 (INIS-BR—1157, pp 89) **Self-diffusion characteristics of some elements considered anomalous.** Dyment, F. (Comision Nacional de Energia Atomica, Buenos Aires (Argentina)). 1981. (In Spanish). NTIS (US Sales Only), PC A06/MF A01. Order Number DE88703560/JAW. (CONF-8109291—).

From 7. Latin American symposium on solid state physics; Gramado, Brazil (14 Sep 1981).

46798 (INIS-BR—1157, pp 93) **Moessbauer spectrocopy of the RCC steel surface implanted with nitrogen; effect of thermal treatment.** Santos, C.A. dos; Souza, J.P. de; Vasquez, A.; Baumvol, I.J.R. (Rio Grande do Norte Univ., Natal (Brazil). Dept. de Fisica; Rio Grande do Sul Univ., Porto Alegre (Brazil). Inst. de Fisica). 1981. (In Portuguese). NTIS (US Sales Only), PC A06/MF/A01. Order Number DE88703560/JAW. (CONF-8109291—).

From 7. Latin American symposium on solid state physics; Gramado, Brazil (14 Sep 1981).

46799 (INIS-BR—1164, pp 120) **Electrolytic purification of niobium.** Jardim, R.F.; Santos, C. (Universidade Estadual de Campinas (Brazil). Inst. de Fisica). 1987. (In Portuguese). NTIS (US Sales Only), PC A09/MF A01. Order Number DE88703566/JAW. (CONF-8705181—).

From 10. national meeting on condensed matter physics; Caxambu, Brazil (5 May 1987).

46800 (INIS-BR—1164, pp 46) **GaAs/GaAlAs heterostructure growth by MOCVD at atmospheric pressure.** Machado, A.M.; Sacilotti, M.A.; Maia, I.A. (TELEBRAS, Campinas (Brazil). Centro de Pesquisas). 1987. (In Portuguese). NTIS (US Sales Only), PC A09/MF A01. Order Number DE88703566/JAW. (CONF-8705181—).

From 10. national meeting on condensed matter physics; Caxambu, Brazil (5 May 1987).

46801 (INIS-BR—1164, pp 94) **Permanent magnets of TR-Fe-B with (BH)/sub max/ = 15MGOe.** Missell, F.P.; Romero, S.A.; Landgraf, F.J.G.; Rodrigues, D. (Instituto de Pesquisas Tecnologicas, Sao Paulo (Brazil)). 1987. (In Portuguese). NTIS (US Sales Only), PC A09/MF A01. Order Number DE88703566/JAW. (CONF-8705181—).

From 10. national meeting on condensed matter physics; Caxambu, Brazil (5 May 1987).

46802 (INIS-BR—1164, pp 95) **Determination of the grain alignment degree of Nd-Fe-B permanent magnets using X-ray.** Gomes, V.V.B.; Missell, F.P. (Sao Paulo Univ. (Brazil). Inst. de Fisica). 1987. (In Portuguese). NTIS (US Sales Only), PC A09/MF A01. Order Number DE88703566/JAW. (CONF-8705181—).

From 10. national meeting on condensed matter physics; Caxambu, Brazil (5 May 1987).

46803 (INIS-BR—1164, pp 180) **Fabrication and characterization of arrangements of Pb/sub 1-x/ Sn/sub x/ Te detectors.** Abramof, E.; Ferreira, S.O.; Boschetti, C.; Cunha, S.P. da; Bandeira, I.N. (Instituto de Pesquisas Espaciais, Sao Jose dos Campos (Brazil)). 1987. (In Portuguese). NTIS (US Sales Only), PC A09/MF A01. Order Number DE88703566/JAW. (CONF-8705181—).

From 10. national meeting on condensed matter physics; Caxambu, Brazil (5 May 1987).

46804 (INIS-BR—1164, pp 28) **Determination of the partial distribution functions by isomorphic substitution.** Bezerra, G.H. (Sao Paulo Univ. (Brazil). Inst. de Fisica). 1987. (In Portuguese). NTIS (US Sales Only), PC A09/MF A01. Order Number DE88703566/JAW. (CONF-8705181—).

From 10. national meeting on condensed matter physics; Caxambu, Brazil (5 May 1987).

46805 (INIS-BR—1164, pp 38) **Figure of merit (Z) variation in 80Si-20Ge sintered and monocrystal alloys.** Assis, O.B.G.; Scalvi, L.V.A.; Mokross, B.J. (Sao Paulo Univ., Sao Carlos, SP (Brazil). Inst. de Fisica e Quimica). 1987. (In Portuguese). NTIS (US Sales Only), PC A09/MF A01. Order Number DE88703566/JAW. (CONF-8705181—).

From 10. national meeting on condensed matter physics; Caxambu, Brazil (5 May 1987).

46806 (INIS-BR—1164, pp 101) **Study of the Fe-Nb diagram.** Zelaya, J.M.; Gama, S. (Universidade Estadual de Campinas (Brazil). Inst. de Fisica). 1987. (In Portuguese). NTIS (US Sales Only), PC A09/MF A01. Order Number DE88703566/JAW. (CONF-8705181—).

From 10. national meeting on condensed matter physics; Caxambu, Brazil (5 May 1987).

46807 (INIS-BR—1164, pp 105) **Determination of induced effects by hydrogen in stainless steels.** Saavedra, A.; Oliveira, S.P. de. (Instituto Militar de Engenharia, Rio de Janeiro (Brazil)). 1987. (In Portuguese). NTIS (US Sales Only), PC A09/MF A01. Order Number DE88703566/JAW. (CONF-8705181—).

From 10. national meeting on condensed matter physics; Caxambu, Brazil (5 May 1987).

46808 (INIS-BR—1164, pp 104) **Study of the steel 304 aging by internal friction technique.** Lima, L.F.C.P. de; Miranda, P.E.V. de; Monteiro, N.S. (Instituto de Pesquisas Energeticas e Nucleares, Sao Paulo (Brazil); Rio de Janeiro Univ. (Brazil). Coordenacao dos Programas de Pos-graduacao de Engenharia). 1987. (In Portuguese). NTIS (US Sales Only), PC A09/MF A01. Order Number DE88703566/JAW. (CONF-8705181—).

From 10. national meeting on condensed matter physics; Caxambu, Brazil (5 May 1987).

46809 (INIS-BR—1164, pp 117) **Model for ultrasonic attenuation and elastic constant in chromium and chromium-vanadium.** Castro, E.P.; Marques, G.E.; Camargo, P.C. de. (Sao Carlos Univ. (Brazil). Dept. de Fisica). 1987. (In Portuguese). NTIS (US Sales Only), PC A09/MF A01. Order Number DE88703566/JAW. (CONF-8705181—).

From 10. national meeting on condensed matter physics; Caxambu, Brazil (5 May 1987).

46810 (INIS-BR—1164, pp 118) **Inelastic relaxation due to interstitials in Nb-50% Ti alloys.** Florencio, O.; Rodrigues, J.A.; Guerrini, O.; Tejima, H.; Jordao, J.A.R. (Universidade Estadual de Maringa (Brazil); Sao Carlos Univ. (Brazil); Sao Carlos Univ. (Brazil). Dept. de Fisica). 1987. (In Portuguese). NTIS (US Sales Only), PC A09/MF A01. Order Number DE88703566/JAW. (CONF-8705181—).

From 10. national meeting on condensed matter physics; Caxambu, Brazil (5 May 1987).

46811 (INIS-BR—1164, pp 2) **New theory for the λ/sub s/ magnetostriction determination by small angle magnetization rotation.** Severino, A.M.; Missell, F.P. (Sao Paulo Univ. (Brazil). Inst. de Fisica). 1987. (In Portuguese). NTIS (US Sales Only), PC A09/MF A01. Order Number DE88703566/JAW. (CONF-8705181—).

From 10. national meeting on condensed matter physics; Caxambu, Brazil (5 May 1987).

46812 (INIS-BR—1164, pp 2) **Magnetic permeability aftereffect in iron-cobalt alloys.** Rezende, A.T. de; Turtelli, R.S. (Universidade Estadual de Campinas (Brazil). Inst. de Fisica). 1987. (In Portuguese). NTIS (US Sales Only), PC A09/MF A01. Order Number DE88703566/JAW. (CONF-8705181—).

From 10. national meeting on condensed matter physics; Caxambu, Brazil (5 May 1987).

46813 (INIS-BR—1164, pp 2) **Fabrication condition effects of the ferromagnetic tapes in the magnetic permeability aftereffect.** Imaizumi, M.; Turtelli, R.S. (Universidade Estadual de Campinas (Brazil). Inst. de Fisica). 1987. (In Portuguese). NTIS (US Sales Only), PC A09/MF A01. Order Number DE88703566/JAW. (CONF-8705181—).

From 10. national meeting on condensed matter physics; Caxambu, Brazil (5 May 1987).

46814 (INIS-BR—1164, pp 6) **Amorphous alloys of high permeability.** Altoe, M.V.P.; Lancarotte, M.S.; Missell, F.P. (Sao Paulo Univ. (Brazil). Inst. de Fisica). 1987. (In Portuguese). NTIS (US Sales Only), PC A09/MF A01. Order Number DE88703566/JAW. (CONF-8705181—).

From 10. national meeting on condensed matter physics; Caxambu, Brazil (5 May 1987).

46815 (INIS-BR—1164, pp 7) **Structural relaxation effects in amorphous ferromagnets.** Alarcon, I.; Lancarotte, M.S.; Santos, A.D. dos; Missell, F.P. (Sao Paulo Univ. (Brazil). Inst. de Fisica). 1987. (In Portuguese). NTIS (US Sales Only), PC A09/MF A01. Order Number DE88703566/JAW. (CONF-8705181—).

From 10. national meeting on condensed matter physics; Caxambu, Brazil (5 May 1987).

46816 (INIS-BR—1164, pp 49) **Photothermal measurements.** Braga, A.J.P.; Neuenschwander, R.T.; Decker, F.; Cesar, C.L.; Penna, A.F.; Mendes Filho, J.; Martins, A.R.M.; Oliveira, A.C. de. (Universidade Estadual de Campinas (Brazil). Inst. de Fisica; Ceara Univ., Fortaleza (Brazil); Sao Carlos Univ. (Brazil)). 1987. (In Portuguese). NTIS (US Sales Only), PC A09/MF A01. Order Number DE88703566/JAW. (CONF-8705181—).

From 10. national meeting on condensed matter physics; Caxambu, Brazil (5 May 1987).

46817 (INIS-BR—1164, pp 95) **Magnetic viscosity in Nd-Fe-B magnets.** Martinez, J.C.G.; Missell, F.P. (Sao Paulo Univ. (Brazil). Inst. de Fisica). 1987. (In Portuguese). NTIS (US Sales Only), PC A09/MF A01. Order Number DE88703566/JAW. (CONF-8705181—).

From 10. national meeting on condensed matter physics; Caxambu, Brazil (5 May 1987).

46818 (INIS-BR—1164, pp 103) **Internal friction and scanning electron microscopy in Nb-Ti-H and Nb-Ti-N alloys.** Florencio, O.; Botta Filho, W.J.; Rodrigues, J.A.; Ishikawa, T.T.; Tejima, H.; Jordao, J.A.R. (Universidade Estadual de Maringa (Brazil)). 1987. (In Portuguese). NTIS (US Sales Only), PC A09/MF A01. Order Number DE88703566/JAW. (CONF-8705181—).

From 10. national meeting on condensed matter physics; Caxambu, Brazil (5 May 1987).

46819 (INIS-BR—1164, pp 104) **Mechanical stress and instabilities in thin films.** Scarminio, J.; Moehlecke, S.; Cardoso, L.P.; Sasaki, J.M. (Universidade Estadual de Campinas (Brazil). Inst. de Fisica). 1987. (In Portuguese). NTIS (US Sales Only), PC A09/MF A01. Order Number DE88703566/JAW. (CONF-8705181—).

From 10. national meeting on condensed matter physics; Caxambu, Brazil (5 May 1987).

46820 (INIS-BR—1180) **Study of tempering process of a DIN 1.2714 steel modified by niobium.** Oliveira, Carlos A.S. de. (Pontificia Univ. Catolica do Rio de Janeiro (Brazil). Dept. de Ciencia dos Materiais e Metalurgia). 1985. 116p. (In Portuguese). NTIS (US Sales Only), PC A06/MF A01. Order Number DE88703873/JAW.

The carbides precipitaton in a DIN 1.2714 steel modified by niobium are studied. Three austenitizing temperatures (1200, 960 and 860/sup 0/C) after homogenization at 1200/sup 0/C are used; and the precipitation behavior of the carbides on tempering at 600/sup 0/C with respect to time is studied. These precipitates were characterized through the X-ray fluorescence and diffraction and by carbon extraction replica techniques for transmission electron-microscope. (M.J.C.).

46821 (INIS-BR—1207) **Quantitative determination of major and minor elements in alloys by emission spectroscopy using Grimm glow discharge lamps.** Fonseca, T.C.O. da. (Pontificia Univ. Catolica do Rio de Janeiro (Brazil). Dept. de Quimica). 1987. 220p. (In Portuguese). NTIS (US Sales Only), PC A10/MF A01. Order Number DE88703898/JAW.

A rapid and simple analytical method for the determination of major, minor and trace elements in alloys, using the Grimm glow discharge lamp as spectroscopic excitation source is studied. Alloys of copper, aluminium, stainless and carbon steel, including the determination of the elements: Cu, Fe, Al, Ni, Cr, Mn, Nb, Si, Mo, Ti, V, Zn, Mg and Co are analyzed. Some parameters as optimal entrance slit position, pre-burning time and integration time of the analytical signal, current, argon pressure, tension pulse and applied power are studied. (M.J.C.).

46822 (KFK—4424) **Crack tip fields in elastic and elastic-plastic materials.** Walz, G.; Stamm, H. (Karlsruhe Univ. (T.H.) (Germany, F.R.). Inst. fuer Zuverlaessigkeit und Schadenskunde im Maschinenbau). (Kernforschungszentrum Karlsruhe G.m.b.H. (Germany, F.R.). Inst. fuer Material- und Festkoerperforschung; Karlsruhe Univ. (T.H.) (Germany, F.R.). Inst. fuer Zuverlaessigkeit und Schadenskunde im Maschinenbau). May 1988. 57p. (In German). NTIS (US Sales Only), PC A04/MF A01. Order Number DE88754605/JAW.

It is shown that the singular stress fields in the immediate vicinity of crack tips can be described by the method of finite elements. For that purpose calculations have been performed for simple crack geometries and model I loading conditions. Linear elastic and power law-creep behaviour is considered. The numerical FE-results agree well with analytic solutions which are known for these two classes of material on the condition that the vicinity of the crack tip is modelled by a sufficiently fine mesh.

46823 (LA-UR—88-427) **Calorimetry study of the synthesis of amorphous Ni-Ti alloys by mechanical alloying.** Schwarz, R.B.; Petrich, R.R. (Los Alamos National Lab., NM (USA)). 1988. Contract W-7405-ENG-36. 32p. (CONF-880837—1). NTIS, PC A03/MF A01; 0; GPO Dep. Order Number DE88006468/JAW.

From International conference on solid state amorphizing transformations; Los Alamos, NM, USA (10 Aug 1988).

0.

We synthesized amorphous $Ni_{33}Ti_{67}$ alloy powder by ball milling (a) a mixture of elemental nickel and titanium powders and (b) powders of the crystalline intermetallic $NiTi_2$. We characterized the reaction products as a function of ball-milling time by differential scanning calorimetry and x-ray diffraction. The measurements suggest that in process (a) the amorphous alloy forms by a solid-state interdiffusion reaction at the clean Ni/Ti interfaces generated by the mechanical attrition. In process (b), the crystalline alloy powder stores energy in the form of chemical disorder and lattice and point defects. The crystal-to-amorphous transformation occurs when the stored energy reaches a critical value. The achievement of the critical stored energy competes with the dynamic recovery of the lattice. 23 refs., 7 figs.

46824 (LA-UR—88-674) **Strain hardening at large strains.** Rollett, A.D.; Kocks, U.F.; Embury, J.D.; Stout, M.G.; Doherty, R.D. (Los Alamos National Lab., NM (USA)). 1988. Contract W-7405-ENG-36. 7p. (CONF-880844—1). NTIS, PC A02/MF A01; 1; GPO Dep. Order Number DE88007909/JAW.

From 8. international conference on strength of metals and alloys; Tampere, Finland (22 Aug 1988).

The strain hardening properties of various fcc metals have been investigated at large strains by means of torsion tests of short thin-walled cylinders. The results show that Stage IV occurs in all cases provided that a low enough test temperature is used; it is a nearly constant hardening rate of 2.10/sup {minus}4/ G in terms of resolved flow stress. Stage IV strain hardening has been modeled by considering the effects of accumulation of dislocation debris, such as dipoles and loops, in the "saturation" stress. The "saturation" stress that can be obtained by extrapolation of Stage III is now a limiting flow stress that slowly increases with the accumulation of debris. The model reproduces the sharp transition from Stage III to Stage IV that occurs experimentally at low temperatures and, for a reasonable choice of parameters, the rate of hardening in Stage IV. 15 refs., 8 figs.

46825 (LA-UR—88-1586) **Microstructure and properties of rapidly solidified beryllium-transition metal alloys.** Jacobson, L.A.; Richardson, S. (Los Alamos National Lab., NM (USA)). 1988. Contract W-7405-ENG-36. 11p. (CONF-880855—2). NTIS, PC A03/MF A01; 1; GPO Dep. Order Number DE88010937/JAW.

From 2. international SAMPE metals and metals processing conference; Dayton, OH, USA (2 Aug 1988).

Alloys of beryllium with small amounts of Ti, Zr and Y (1-3 wt %) were rapidly solidified using an arc hammer splat technique. Each of these elements forms a dilute eutectic with beryllium, and has very low solid solubility in the alpha phase. In the case of Ti, the Be-rich compound is $TiBe_{12}$, and for Zr and Y, the compound is MBe. The objective of the work was to achieve a fine, uniform dispersion of particles of the intermetallic compound. Since these compounds have very high melting points, it was expected that rapidly solidified microstructures would be relatively stable at elevated temperatures. This microstructural stability should result in improved high temperature properties for the alloys. Microstructures have been characterized using optical, scanning and transmission electron microscopy. Microhardness measurements have been made in order to determine the effects of rapid solidification and to evaluate the effects of high temperature exposure on microstructural stability and property retention. The results will be presented in light of the potential of these alloys for intermediate temperature application. 12 refs., 8 figs.

46826 (LA-UR—88-1914) **Electrical resistivity of U/sub 1{minus}x/M/sub x/Be_{13} under pressure.** Borges, H.A.; Thompson, J.D.; Aronson, M.C.; Fisk, Z.; Smith, J.L. (Los Alamos National Lab., NM (USA)). 1988. Contract W-7405-ENG-36. 9p. (CONF-880704—2). NTIS, PC A02/MF A01; 1; GPO Dep. Order Number DE88014449/JAW.

From 6. international conference on crystal field effects and heavy fermion physics; Frankfurt, F.R. Germany (18 Jul 1988).

Measurements of the electrical resistivity of U/sub 1{minus}x/ Th/sub x/ Be_{13} compounds as a function of pressure provide a possible explanation for the unusual behavior of these materials. 10 refs., 2 figs.

46827 (LA-UR—88-1926) Low temperature measurements on UBe_{13}. Brison, J.P.; Lasjaunias, J.C.; Ravex, A.; Flouquet, J.; Jaccard, D.; Fisk, Z.; Smith, J.L. (Los Alamos National Lab., NM (USA); Centre National de la Recherche Scientifique, 38 - Grenoble (France). Centre de Recherches sur les Tres Basses Temperatures; CEA Centre d'Etudes Nucleaires de Grenoble, 38 (France). Service des Basses Temperatures; Geneva Univ. (Switzerland). Dept. de Physique de la Matiere Condensee). 1988. Contract W-7405-ENG-36. 3p. (CONF-880206—15). NTIS, PC A02. Order Number DE88014446/JAW.

From International conference on high temperature superconductors and materials and mechanisms of superconductivity; Interlaken, Switzerland (29 Feb 1988).

Transport and specific heat measurements are reported on a new sample of UBe_{13}. Special focuses are given on the zero field specific heat : at low temperature ($T < 150$ mK) where the impurity scattering dominates, at intermediate temperature where a quani T_3 law characteristic of an axial state is obeyed and near the critical temperature where critical fluctuations are observed. Correlations are made with magnetoresistivity and thermal conductivity experiments. 9 refs., 2 figs.

46828 (LBL—24875) Generation of the J/sub c/, H/sub c/, T/sub c/ surface for commercial superconductor using reduced-state parameters. Green, M.A. (Lawrence Berkeley Lab., CA (USA)). Apr 1988. Contract AC03-76SF00098. 67p. NTIS, PC A04/MF A01; 1; GPO Dep. Order Number DE88014038/JAW.

This report presents a method for calculating the J/sub C/, H/sub C/, T/sub C/ surface for Type II Superconductors. The method requires that one knows T/sub C/ at zero current and field, H/sub c2/ at zero current and temperature, and J/sub c/ at at least one temperature and field. The theory presented in this report agrees with the measured data quite well over virtually the entire J/sub c/, H/sub c/, T/sub c/ surface given the value of J/sub c/ versus H at one or two temperatures. This report presents calculated and measured values of J/sub c/ versus T and B for niobium titanium, niobium zirconium, niobium tin, niobium titanium tin, niobium tantalum tin, vanadium zirconium hafnium, and vanadium gallium. Good agreement of theory with measured data was obtained for commercial niobium titanium and niobium tin. 76 refs., 26 figs., 6 tabs.

46829 (N—88-22168) Bithermal fatigue of a nickel-base superalloy single crystal. Verrilli, M.J. (National Aeronautics and Space Administration, Cleveland, OH (USA). Lewis Research Center). May 1988. 15p. (NASA-TM—100885; E—4118; NAS—1.15:100885). NTIS, PC A03/MF A01.

The thermomechanical fatigue behavior of a nickel-base superalloy single crystal was investigated using a bithermal test technique. The bithermal fatigue test was used as a simple alternative to the more complex thermomechanical fatigue test. Both in-phase and out-of-phase bithermal tests were performed on (100)-oriented coated and bare Rene N4 single crystals. In out-of-plane bithermal tests, the tensile and compressive halves of the cycle were applied isothermally at 760 and 982 C, respectively, while for the in-phase bithermal tests the temperature-loading sequence was reversed. The bithermal fatigue lives of bare specimens were shorter than the isothermal fatigue lives at either temperature extreme when compared on an inelastic strain basis. Both in-phase and out-of-phase bithermal fatigue life curves converged in the large strain regime and diverged in the small strain regime, out-of-phase resulting in the shortest lives. The coating had no effect on life for specimens cycled in-phase; however, the coating was detrimental for isothermal fatigue at 760 C and for out-of-phase fatigue under large strains.

46830 (N—88-22382, pp vp) Biaxial experiments supporting the development of constitutive theories for advanced high-temperature materials. Ellis, J.R. May 1988. NTIS, PC A14/MF A01. (NASA-CP—3003-VOL-2; E—3970-VOL-2; NAS—1.55:3003-VOL-2; CONF-8805178—).

From Lewis structures technology symposium; Cleveland, OH, USA (24 May 1988).

Complex states of stress and strain are introduced into components during service in engineering applications. It follows that analysis of such components requires material descriptions, or constitutive theories, which reflect the tensorial nature of stress and strain. For applications involving stress levels above yield, the situation is more complex in that material response is both nonlinear and history dependent. This has led to the development of viscoplastic constitutive theories which introduce time by expressing the flow and evolutionary equation in the form of time derivatives. Models were developed here which can be used to analyze high temperature components manufactured from advanced composite materials. In parallel with these studies, effort was directed at developing multiaxial testing techniques to verify the various theories. Recent progress in the development of constitutive theories from both the theoretical and experimental viewpoints are outlined. One important aspect is that material descriptions for advanced composite materials which can be implemented in general purpose finite element codes and used for practical design are verified.

46831 (N—88-22382, pp vp) Unified constitutive model development for metal matrix composites at high temperature. Robinson, D.N. May 1988. NTIS, PC A14/MF A01. (NASA-CP—3003-VOL-2; E—3970-VOL-2; NAS—1.55:3003-VOL-2; CONF-8805178—).

From Lewis structures technology symposium; Cleveland, OH, USA (24 May 1988).

Structural alloys used in high temperature applications exhibit complex thermomechanical behavior that is time dependent and hereditary. Recent attention is being focused on metal matrix composite materials for high temperature applications where they exhibit all the complexities of conventional alloys and their strong anisotropy adds further complexities. Here, a proven constitutive model for isotropic materials in which the inelastic strain rate and internal state are expressible as gradients of a dissipation potential is taken to depend on invariants that reflect local transverse isotropy. Applications illustrate the capability of the theory of representing the time dependent, hereditary, anisotropic behavior typical of these materials at high temperature.

46832 (N—88-22382, pp vp) Unified constitutive model for single crystal deformation behavior with applications. Walker, K.P.; Meyer, T.G.; Jordan, E.H. (Connecticut Univ., Storrs (USA)). May 1988. NTIS, PC A14/MF A01. (NASA-CP—3003-VOL-2; E—3970-VOL-2; NAS—1.55:3003-VOL-2; CONF-8805178—).

From Lewis structures technology symposium; Cleveland, OH, USA (24 May 1988).

Single crystal materials are being used in gas turbine airfoils and are candidates for other hot section components because of their increased temperature capabilities and resistance to thermal fatigue. Development of a constitutive model which assesses the inelastic behavior of these materials has been studied in 2 NASA programs: Life Prediction and Constitutive Models for Engine Hot Section Anisotropic Materials and Biaxial Constitutive Equation Development for Single Crystals. The model has been fit to a large body of constitutive data for single crystal PWA 1480 material. The model uses a unified approach for computing total inelastic strains (creep plus plasticity) on crystallographic slip systems reproducing observed directional and strain rate effects as a natural consequence of the summed slip system quantities. The model includes several of the effects that have been reported to influence deformation in single crystal materials, such as shear stress, latent hardening, and cross slip. The model is operational in a commercial finite element code and is being installed in a boundary element method code.

46833 (N—88-22382, pp vp) Three-dimensional inelastic approximate analysis code (MOMM). Meister, J.P. May 1988. NTIS, PC A14/MF A01. (NASA-CP—3003-VOL-2; E—3970-VOL-2; NAS—1.55:3003-VOL-2; CONF-8805178—).

From Lewis structures technology symposium; Cleveland, OH, USA (24 May 1988).

The Mechanics of Materials Model (MOMM) is one of a series of new stand-alone three dimensional nonlinear structural analysis codes. Incorporation of a general purpose finite element computer code into the hot section design process was severely limited by the high costs involved. MOMM is a stiffness method

finite element code that uses an internally generated network of beams to characterize hot section component behavior. The method was proposed as a fast, easy to use, computationally efficient tool for approximate analyses. MOMM incorporates a wide variety of analysis capabilities, material models, and load type specifiers instrumental for the analysis of hot section components.

46834 (N—88-22382, pp vp) **METCAN: the metal matrix composite analyzer.** Hopkins, D.A.; Murthy, P.L.N. (Cleveland State Univ., OH (USA)). May 1988. NTIS, PC A14/MF A01. (NASA-CP—3003-VOL-2; E—3970-VOL-2; NAS—1.55:3003-VOL-2; CONF-8805178—).

From Lewis structures technology symposium; Cleveland, OH, USA (24 May 1988).

Metal matrix composites (MMC) are the subject of intensive study and are receiving serious consideration for critical structural applications in advanced aerospace systems. MMC structural analysis and design methodologies are studied. Predicting the mechanical and thermal behavior and the structural response of components fabricated from MMC requires the use of a variety of mathematical models. These models relate stresses to applied forces, stress intensities at the tips of cracks to nominal stresses, buckling resistance to, applied force, or vibration response to excitation forces. The extensive research in computational mechanics methods for predicting the nonlinear behavior of MMC are described. This research has culminated in the development of the METCAN (METal Matrix Composite ANalyzer) computer code.

46835 (N—88-22382, pp vp) **Structural analyses of engine wall cooling concepts and materials.** Kaufman, A. May 1988. NTIS, PC A14/MF A01. (NASA-CP—3003-VOL-2; E—3970-VOL-2; NAS—1.55:3003-VOL-2; CONF-8805178—).

From Lewis structures technology symposium; Cleveland, OH, USA (24 May 1988).

The severe thermal environments under which hypersonic aircraft such as the National Aerospace Plane (NASP) will operate require cooling of the engine walls, especially in the combustor. A preliminary assessment is made of some candidate materials based on structural analyses for a number of convective cooling configurations. Three materials were studied: graphite/copper and tungsten/copper composite alloys with 50 percent fiber volume fractions and a wrought cobalt-base superalloy, Haynes 188. Anisotropic mechanical and thermal properties for the composites were obtained from a computer code, ICAN, which determines the composite material properties from the individual properties of the fiber and matrix materials. The structural analyses were performed by using the MARC nonlinear finite element code. Heat transfer analyses were conducted to calculate the metal temperature distributions.

46836 (N—88-22408, pp vp) **Elevated temperature crack growth.** Kim, K.S.; Vanstone, R.H.; Malik, S.N.; Laflen, J.H. May 1988. NTIS, PC A16/MF A01. (NASA-CP—3003-VOL-3; E—3970-VOL-3; NAS—1.55:3003-VOL-3; CONF-8805178—).

From Lewis structures technology symposium; Cleveland, OH, USA (24 May 1988).

The problem of crack growth in hot path components such as combustor liners is complicated by several practical and theoretical considerations. The loading environment of such components involves high temperature levels and gradients that lead to considerations such as thermal stresses, crack closure, hold time, inelastic strains (both time dependent and independent), and Thermal Mechanical Fatigue (TMF). In general, a good understanding of the influence of these factors on crack growth was not obtained. At the same time, several nonlinear fracture mechanics parameters were suggested for such applications; however, most of the proposed methods were not tested for broad applications such as required for hot section components. It was the purpose of this program to evaluate proposed nonlinear methods by performing a thorough experimental and analytical study. The results illustrated that much progress was made in developing nonlinear methods.

46837 (N—88-22408, pp vp) **Bithermal fatigue: a simplified alternative to thermomechanical fatigue.** Verrilli, M.J. May 1988. NTIS, PC A16/MF A01. (NASA-CP—3003-VOL-3; E—3970-VOL-3; NAS—1.55:3003-VOL-3; CONF-8805178—).

From Lewis structures technology symposium; Cleveland, OH, USA (24 May 1988).

A bithermal fatigue test technique was proposed as a simplified alternative to the thermomechanical fatigue test. Both the thermomechanical cycle and the bithermal technique can be used to study nonisothermal fatigue behavior. The difference between the two cycles is that in a conventional thermomechanical fatigue cycle the temperature is continuously varied concurrently with the applied mechanical strains, but in the bithermal fatigue cycle the specimen is held at zero load during the temperature excursions and all the loads are applied at the two extreme temperatures of the cycle. Experimentally, the bithermal fatigue test technique offers advantages such as ease in synchronizing the temperature and mechanical strain waveforms, in minimizing temperature gradients in the specimen gauge length, and in reducing and interpreting thermal fatigue such as the influence of alternate high and low temperatures on the cyclic stress-strain response characteristics, the effects of thermal state, and the possibility of introducing high- and low-temperature deformation mechanisms within the same cycle. The bithermal technique was used to study nonisothermal fatigue behavior of alloys such as single-crystal PWA 1480, single-crystal Rene N4, cast B1900+Hf, and wrought Haynes 188.

46838 (N—88-22408, pp vp) **Life prediction modeling based on cyclic damage accumulation.** Nelson, R.S. May 1988. NTIS, PC A16/MF A01. (NASA-CP—3003-VOL-3; E—3970-VOL-3; NAS—1.55:3003-VOL-3; CONF-8805178—).

From Lewis structures technology symposium; Cleveland, OH, USA (24 May 1988).

A high temperature, low cycle fatigue life prediction method was developed. This method, Cyclic Damage Accumulation (CDA), was developed for use in predicting the crack initiation lifetime of gas turbine engine materials, where initiation was defined as a 0.030 inch surface length crack. A principal engineering feature of the CDA method is the minimum data base required for implementation. Model constants can be evaluated through a few simple specimen tests such as monotonic loading and rapic cycle fatigue. The method was expanded to account for the effects on creep-fatigue life of complex loadings such as thermomechanical fatigue, hold periods, waveshapes, mean stresses, multiaxiality, cumulative damage, coatings, and environmental attack. A significant data base was generated on the behavior of the cast nickel-base superalloy B1900+Hf, including hundreds of specimen tests under such loading conditions. This information is being used to refine and extend the CDA life prediction model, which is now nearing completion. The model is also being verified using additional specimen tests on wrought INCO 718, and the final version of the model is expected to be adaptable to most any high-temperature alloy. The model is currently available in the form of equations and related constants. A proposed contract addition will make the model available in the near future in the form of a computer code to potential users.

46839 (N—88-22408, pp vp) **Fatigue damage modeling for coated single crystal superalloys.** Nissley, D.M. May 1988. NTIS, PC A16/MF A01. (NASA-CP—3003-VOL-3; E—3970-VOL-3; NAS—1.55:3003-VOL-3; CONF-8805178—).

From Lewis structures technology symposium; Cleveland, OH, USA (24 May 1988).

A high temperature, low-cycle fatigue life prediction method for coated single crystal nickel-base superalloys is being developed. The method is being developed for use in predicting crack initiation life of coated single crystal turbine airfoils. Although the models are being developed using coated single crystal PWA 1480, they should be readily adaptable to other coated nickel-base single crystal materials. The coatings choosen for this effort were of two generic types: a low pressure plasma sprayed NiCoCrAlY overlay, designated PWA 286, and an aluminide diffusion, designated PWA 273. In order to predict the useful crack initiation life of airfoils, the

constitutive and failure behavior of the coating/substrate combination must be taken into account. Coatings alter the airfoil surface microstructure and are a primary source from which cracks originate. The adopted life prediction approach addresses this complexity by separating the coating and single crystal crack initiation regimes. This provides a flexible means for using different life model formulations for the coating and single crystal materials. At the completion of this program, all constitutive and life model formulations will be available in equation form and as software. The software will use the MARC general purpose finite element code to drive the constitutive models and calculate life parameters.

46840 (NAGRA-NTB—87-06, pp 1-22) **Temperature fields at seam weldings: analytical calculations.** Meyer, R. (Senap AG, Zurich (Switzerland)). Dec 1987. (In German). Nagra, CH-5401 Baden, Switzerland.

In Transient temperature fields at seam weldings.

The modelling of the transient temperature fields occurring at seam weldings is a first step in the calculation of welding-induced residual stresses. Both an analytical and a finite element method were used for the calculation and the results for both methods were compared with those published for experimental investigations. Taking into consideration the simplifications made, particularly in the case of the analytical method, the agreement between the results can be rated as very good. (author) 3 refs., 9 figs., 3 tabs.

46841 (NAGRA-NTB—87-06, pp 23-98) **Container for final storage of high-level radioactive wastes: calculation of instationary temperature fields.** Attinger, R. (2314000CH). Dec 1987. (In German). Nagra, CH-5401 Baden, Switzerland.

In Transient temperature fields at seam weldings.

The modelling of the transient temperature fields occurring at seam weldings is a first step in the calculation of welding-induced residual stresses. Both an analytical and a finite element method were used for the calculation and the results for both methods were compared with those published for experimental investigations. Taking into consideration the simplifications made, particularly in the case of the analytical method, the agreement between the results can be rated as very good. (author) 20 refs., 50 figs., 5 tabs.

46842 (ND-R—1430(R)) **Reference upper shelf fracture toughness properties of PWR pressure vessel materials: neutral/basic flux PWR submerged-arc welds.** Lidbury, D.P.G. (UKAEA Northern Research Labs., Risley). Oct 1987. 31p. NTIS (US Sales Only), PC A03/MF A01. Order Number DE88754290/JAW.

A generic data base, relating to the upper shelf fracture toughness properties (O ≦ T ≦ 300/sup 0/C) of pressurised water reactor (PWR) pressure vessel submerged-arc welds, deposited using neutral or basic fluxes, has been compiled and is presented in summary form within the main body of this report. A comparison with the A533B-1 plate and A508-3 forging data presented in the Second (1982) Report of the Light Water Reactor Study Group suggests the upper shelf fracture toughness properties of RPV submerged-arc welds metals are such that, over the temperature range appropriate to PWR plant operation: (i) initiation toughnesses are generally less than those associated with A533B-1/A508-3 base metals containing < 0.010 wt% S; (ii) enhanced toughnesses, corresponding to 2.0 mm stable crack extension, are comparable with those expected of A533B-1 plate materials containing < 0.010 wt% S. The information gathering exercise has also confirmed that upper shelf toughnesses associated with the use of basic or neutral fluxes are higher than those associated with the use of acidic fluxes.

46843 (ORNL/Sub—83-43346/01) **Breakdown mechanisms of preformed Al_2O_3, Cr_2O_3 and SiO_2 scales in H_2/H_2O/H_2S environments at 950{degree}C.** Kim, G.M.; Meier, G.H. (Oak Ridge National Lab., TN (USA); Pittsburgh Univ., PA (USA). Dept. of Materials Science and Engineering). 1 Jun 1988. Contract AC05-84OR21400. 63p. NTIS, PC A04. Order Number DE88013705/JAW.

The breakdown mechanisms of preformed oxide scales, Cr_2O_3, Al_2O_3 and SiO_2, have been studied at 950{degree}C at low oxygen and high sulfur potentials. For Cr_2O_3 on Ni-30Cr, sulfur penetration occurs through thin areas in the Cr_2O_3 scale. These thinner areas were formed over voids formed during preoxidation because the voids act as chromium diffusion barriers. Internal sulfides form at the rim of the voids where the chromium activity is high. The filling of voids by sulfides and the progressive formation of sulfides through the scale establish sulfide rich channels which are easy paths for cation transport. The breakdown occurs once the channels are introduced. For Al_2O_3 on Fe-18Cr-6Al-1Hf, sulfur reacts with metallic iron on the surface and HfO_2 extending through the Al_2O_3 scale to form iron sulfides and hafnium rich sulfides, respectively. These sulfides provide easy paths for inward diffusion of sulfur ions and outward diffusion of base metal ions to form internal sulfides at the craters around Hf rich phases, and external sulfides at the scale/gas interface, respectively. For SiO_2 on Ni-20Si, although porosity can form at the scale/gas interface due to the high vapor pressures of SiS and SiO, the formation of a thin layer of vitreous silica and good scale adherence provide better resistance to sulfur penetration than do Cr_2O_3 and Al_2O_3. 33 refs., 30 figs., 2 tabs.

46844 (POEF-T—3487) **Corrosion of nickel and Monel welds of steel in chlorine trifluoride.** Fout, S.L. (Portsmouth Gaseous Diffusion Plant, OH (USA)). 25 Jul 1988. Contract AC05-76OR00001. 14p. NTIS, PC A03/MF A01; 1; GPO Dep. Order Number DE88014122/JAW.

Failures in the weld areas of nickel-plated steel pipe carrying chlorine trifluoride, ClF_3, prompted this investigation to determine the effect of weld composition on corrosion by ClF_3. Monel/steel and nickel/steel alloys of composition to simulate weld overlays were tested to determine their corrosion rates in ClF_3 at 200{degree}F and 300{degree}F. For both nickel/steel and Monel/steel, the corrosion rate was higher at the higher temperature. For nickel/steel alloys at compositions up to 50% iron, which would cover a range considered normal for welding, the corrosion rate would be within acceptable limits. For Monel/steel alloys, compositions up to 35% iron have an acceptable corrosion rate. Above this, the corrosion would be greater than a tolerable amount. It should pose no problem to keep the heat input to the weld low enough to produce a Monel weld with an iron content below 35%. 2 refs., 5 figs., 2 tabs.

46845 (SAND—88-0662C) **Nitride layer growth in iron and titanium alloys: Studies by electron probe microanalysis.** Romig, A.D. Jr.; Semarge, R.E.; Metin, E.; Inal, O.T. (Sandia National Labs., Albuquerque, NM (USA)). 1988. Contract AC04-76DP00789. 21p. (CONF-880841—4). NTIS, PC A03/MF A01; 1; GPO Dep. Order Number DE88007207/JAW.

From MAS/EMSA microbeam analysis conference; Milwaukee, WI, USA (7 Aug 1988).

The present study addresses the surface hardening of Fe and Ti by plasma nitriding. The work describes quantitative electron probe microanalysis of the nitride layers and composition gradients which form during the nitriding process in iron (600{degree}C) and titanium (800-1080{degree}C). Such measurements are the key to developing quantitative diffusion models for the nitriding reaction which are necessary to optimize the nitriding process (e.g., prediction of microstructural evolution as a function of time and temperature). It is the objective of the present work to develop the quantitative electron probe microanalysis (EPMA) techniques to determine the compositions of Fe and Ti nitrides and to measure concentration gradients of N in metallic phases of Fe and Ti. 17 refs., 8 figs.

46846 (Y/DK—496) **A relatively inert material for casting uranium and uranium alloys.** Walker, L.R.; Holcombe, C.E.; Swartout, W.M.; Thompson, K.A. (Oak Ridge Y-12 Plant, TN (USA)). 5 Sep 1986. Contract AC05-84OS21400. 13p. (CONF-860829—43). NTIS, PC A03. Order Number DE88012771/JAW.

From Annual joint meeting of the Electron Microscopy Society of America and the Microbeam Analysis Society; Albuquerque, NM, USA (10 Aug 1986).

Uranium and uranium alloys are typically induction melted in graphite crucibles under vacuum; but because of the chemical reactivity of the metal and the alloy constituents with graphite, cruci-

bles must be protected with a nonreactive coating. Over the years several metal oxides have been used as protective coatings with varying degrees of success. A material that resists chemical activity, that is not wetted by the uranium or alloys, reduces carbon contamination, and is heat conductive would be a desirable alternative to the carbon crucibles with protective coatings. In this study a new material produced by Fansteel, Tribocor 532N, is examined as a possible replacement for graphite. It is a surface-nitrided 50% Nb-30% Ti-20% W alloy. It has many desirable features, such as good heat conductivity and easy toolability; it has been found to be fairly unreactive to uranium and two other alloys that were studied, although one alloy did show some interaction. Results of this study indicates a high potential for this new material. 6 refs., 4 figs., 1 tab.

46847 **Polarization and resonance properties of magnetic x-ray scattering in holmium.** Gibbs, D.; Harshman, D.R.; Isaacs, E.D.; McWhan, D.B.; Mills, D.; Vettier, C. (Brookhaven National Laboratory, Upton, New York 11973). *Physical Review Letters;* **61**: No. 10, 1241-1244(5 Sep 1988).

By measuring the degree of linear polarization we identify the orbital and spin contributions to the x-ray magnetic scattering in holmium. When the incident x-ray energy is tuned through the L/sub III/ absorption edge, we observe a fiftyfold resonant enhancement of the magnetic signal, and resonant integer harmonics. The line shapes of the two linear components scattered parallel and perpendicular to the diffraction plane are distinct in energy with a 6-eV splitting.

46848 **X-ray resonance exchange scattering.** Hannon, J.P.; Trammell, G.T.; Blume, M.; Gibbs, D. (Physics Department, Rice University, Houston, Texas 77251). *Physical Review Letters;* **61**: No. 10, 1245-1248(5 Sep 1988).

Large resonant magnetization-sensitive x-ray scattering is predicted to occur in the vicinity of the L/sub II/, L/sub III/, and M/sub II/—M/sub V/ absorption edges in the rare-earth and actinide elements, and at the K and L edges in the transition elements. These "magnetic" resonances result from electric multipole transitions, with the sensitivity to the magnetization arising from exchange. For some transitions, the magnetic scattering will be comparable to the charge scattering. The general features of the observed L/sub III/ resonance in Ho are discussed.

46849 **Spin-polarized tunneling study of s-f exchange in superconductors.** Tkaczyk, J.E.; Tedrow, P.M. (Francis Bitter National Magnet Laboratory, Cambridge, Massachusetts 02139). *Physical Review Letters;* **61**: No. 10, 1253-1256(5 Sep 1988).

Spin-polarized tunneling into the side of an Al film covered with a submonolayer of Gd reveals the presence of the localized Ruderman-Kittel-Kasuya-Yosida spin polarization in the normal state and its absence in the superconducting state. This result is attributed to the fact that the long-range part of the spin susceptibility in the superconductor vanishes at low temperature. The exchange constant is derived from the Zeeman splitting of the superconductor density of states, and its value agrees with that obtained from the Abrikosov-Gor'kov theory.

46850 **Intensities of backscatter Moessbauer spectra.** Mei, Z.; Fultz, B.; Morris J.W. Jr. (Center for Advanced Materials, Lawrence Berkeley Laboratory and Department of Materials Science and Mineral Engineering, University of California, Berkeley, California 94720). *Journal of Applied Physics;* **64**: No. 5, 2550-2555(1 Sep 1988).

The intensities of γ-ray and x-ray backscatter Moessbauer spectra of ^{57}Fe nuclei in different matrix materials were studied theoretically and experimentally. A previous analysis by J. J. Bara [Phys. Status Solidi A 58, 349 (1980)] showed that negative peak intensities occur in backscatter γ-ray spectra when the ^{57}Fe nuclei are in a matrix of light elements. We report a confirmation of this work and offer a simple explanation of the phenomenon. The present paper extends Bara's analysis to the case of conversion x-ray spectra; expressions for the intensity of conversion x-ray spectra as a function of absorber thickness and absorber material parameters are presented. We show that negative peak intensities are expected in conversion x-ray spectra when the ^{57}Fe nuclei are in a matrix of heavy elements.

46851 **Residual stress anisotropy, stress control, and resistivity in post cathode magnetron sputter deposited molybdenum films.** Cuthrell, R.E.; Mattox, D.M.; Peeples, C.R.; Dreike, P.L.; Lamppa, K.P. (Sandia National Laboratories, Albuquerque, New Mexico 87185). *Journal of Vacuum Science and Technology, A: Vacuum, Surfaces, and Films;* **6**: No. 5, 2914-2920(Sep 1988).

As part of the program to develop a large-area thin-film pulse heater for a lithium ion source, the residual stress in post cathode magnetron sputter deposited molybdenum films has been studied. It was found that in films prepared in the low-pressure sputtering regime, the residual film stress is very sensitive to the gas pressure during sputtering and that the film stresses are highly anisotropic. The transition pressure for changing from compressive to tensile residual stress, as defined by Thornton and Hoffman, depends on the relationship between the measurement direction in the film and the post cathode orientation. In order to deposit a nearly stress-free film a pressure cycling technique was developed which deposited alternate film layers containing tensile and compressive stresses. Film resistivity and thermal coefficient of resistivity measurements were made during the pulse heating of the molybdenum films.

46852 **Unoccupied-band narrowing in Na and its effect on the x-ray-absorption K edge.** Citrin, P.H.; Wertheim, G.K.; Hashizume, T.; Sette, F.; MacDowell, A.A.; Comin, F. (AT&T Bell Laboratories, Murray Hill, New Jersey 07974). *Physical Review Letters;* **61**: No. 8, 1021-1024(22 Aug 1988).

The first Na K-edge absorption measurements are reported. The data reveal a narrowing of the unfilled density of states analogous to that observed in a recent photoemission study of the conduction band and in very good agreement with new band-structure calculations. The narrowing is found to be essential for obtaining compatibility among the K-edge threshold exponent, the L/sub 2,3/-edge exponent, and the singularity index in core-level photoemission.

46853 **Short-range structure of Al-Mn and Al-Mn-Si aperiodic alloys.** Ma, Y.; Stern, E.A. (Physics Department, FM-15, University of Washington, Seattle, Washington 98195). *Physical Review [Section] B: Condensed Matter;* **38**: No. 6, 3754-3765(15 Aug 1988).

X-ray-absorption fine-structure results on the icosahedral Al-Mn and Al-Mn-Si, α-(Al-Mn-Si), and decagonal Al-Mn alloys are presented. High-resolution first-shell Al radial distributions around Mn atoms were obtained using a newly developed, direct Fourier-transform method. The first and second Mn shells are analyzed in detail. The Al and Mn positions on the structural unit of the icosahedral phase are determined from these results. The result is in agreement with the speculation that the structural unit is a Mackay icosahedron (MI). Furthermore, it is found that about 40% of the MI units in the icosahedral phase have the same connection as that in α-(Al-Mn-Si) and the average coordination number of the MI is about 7 in the icosahedral phase. The MI units also closely resemble those in the α phase, including the distortion induced by the cubic packing of the MI's in α-(Al-Mn-Si). These results suggest the presence of a short-range cubic environment in the icosahedral phase with an estimated correlation length of about 20 A. These results are in disagreement with both the completely random accretion of oriented MI units and a quasicrystalline arrangement of the MI. Results on the decagonal Al-Mn phase and the role of Si in icosahedral Al-Mn-Si are also discussed.

46854 **Photoemission spectra and band structures of simple metals.** Shung, K.W.; Mahan, G.D. (Solid State Division, Oak Ridge National Laboratory, Oak Ridge, Tennessee 37831). *Physical Review [Section] B: Condensed Matter;* **38**: No. 6, 3856-3865(15 Aug 1988).

We present a detailed calculation of the angle-resolved photoemission spectra of Na. The calculation follows a theory by Mahan, which allows for the inclusion of various bulk and surface effects. We find it important to take into account various broadening effects in order to explain the anomalous structure at E/sub F/, which was found by Jensen and Plummer in the spectra of Na. The broadening effects also help to resolve the discrepancy of the con-

duction-band width. Efforts are made to compare our results with new measurements of Plummer and Lyo. We discuss the ambiguity concerning the sign of the crystal potential and comment on charge-density waves in the systems. We have also generalized our discussions to other simple metals like K.

46855 Plasmon- and phonon-assisted recombinations in germanium. Rasolt, M.; Perrot, F. (Solid State Division, Oak Ridge National Laboratory, Oak Ridge, Tennessee 37831). *Physical Review [Section] B: Condensed Matter;* **38**: No. 6, 4130-4135(15 Aug 1988).

We present a detailed theoretical calculation of the plasmon- and phonon-assisted recombination (PPAR) in Ge. We present results for PPAR as a function of carrier density and lattice temperature. Differences of recombination processes in Ge versus Si are particularly emphasized.

46856 Growth and thermal stability of Ag or Au films on Nb(110). Ruckman, M.W.; Jiang, L. (Brookhaven National Laboratory, Upton, New York 11973-5000). *Physical Review [Section] B: Condensed Matter;* **38**: No. 5, 2959-2966(15 Aug 1988).

The growth and thermal stability of ultrathin (<50-A-thick) Ag and Au films on Nb(110) was investigated with use of photoemission spectroscopy and low-energy electron-diffraction (LEED) patterns. The LEED results show that Ag or Au forms a monolayer which is commensurate with the substrate, but also show that the structure of this overlayer reverts to a more close-packed structure after three monolayers (ML) have been deposited. Photoemission spectra show trends that suggest the evolution of the Ag or Au band structure with coverage and also show that a surface deposit of at least 2 ML of Ag or Au is required to observe valence-band states characteristic of the bulk metal. Further examination of the photoemission spectra suggests that the Ag or Au d-band states play only a small role in the chemical bonding that occurs between the noble metals and Nb(110), and this can be contrasted with the extensive d-band involvement in chemisorption bonds formed between Pd or Pt and Nb(110). Heating does not cause substantial change in the electric structure of 12.8-ML-thick Ag films and they thermally desorb from Nb when heated above 830 K. Similar Au films intermix with Nb to form a disordered surface phase when heated beyond 750 K. Desorption or complete in-diffusion of Au occurs when the substrate is heated beyond 1100 K. Implications for the formation of strained surface layers and surface chemical properties of noble metals on Nb(110) are discussed.

46857 Theory of electronic structure and magnetic behavior of fcc iron grown on Cu(001). Fernando, G.W.; Cooper, B.R. (Department of Physics, Brookhaven National Laboratory, Upton, New York 11973-5000). *Physical Review [Section] B: Condensed Matter;* **38**: No. 5, 3016-3027(15 Aug 1988).

The self-consistent film linearized muffin-tin-orbital method has been used to calculate the magnetically ordered and paramagnetic electronic structure of fcc iron as grown on Cu(001). Some recent experimental and theoretical work on this system is critically examined. Our calculations indicate that the zero-temperature ground state of this system has an antiferromagnetic interior and ferromagnetic coupling at the surface with an enhanced surface magnetic moment of 2.8μ/sub B/. .AE

46858 Density-functional formulation of the generalized pseudopotential theory. III. Transition-metal interatomic potentials. Moriarty, J.A. (Lawrence Livermore National Laboratory, University of California, Livermore, California 94550). *Physical Review [Section] B: Condensed Matter;* **38**: No. 5, 3199-3231(15 Aug 1988).

The first-principles, density-functional version of the generalized pseudopotential theory (GPT) developed in papers I and II of this series [Phys. Rev. B 16, 2537 (1977); 26, 1754 (1982)] for empty- and filled-d-band metals is here extended to pure transition metals with partially filled d bands. The present focus is on a rigorous, real-space expansion of the bulk total energy in terms of widely transferable, structure-independent interatomic potentials, including both central-force pair interactions and angular-force triplet and quadruplet interactions. To accomplish this expansion, a specialized set of starting equations is derived from the basic local-density formalism for a pure metal, including refined expansions for the exchange-correlation terms and a simplified yet accurate representation of the cohesive energy. The parent pseudo-Green's-function formalism of the GPT is then used to develop these equations in a plane-wave, localized-d-state basis. In this basis, the cohesive energy divides quite naturally into a large volume component and a smaller structural component.

46859 Observation of incommensurate spin-density-wave paramagnons. Fawcett, E.; Werner, S.A.; Goldman, A.; Shirane, G. (Physics Department, University of Toronto, Toronto, Canada M5Schemical bond1A7). *Physical Review Letters;* **61**: No. 5, 558-561(1 Aug 1988).

Magnetic fluctuations seen by inelastic neutron scattering in the paramagnet Cr/sub 0.95/V/sub 0.05/ have a structure factor similar to that of the static incommensurate spin-density wave (SDW) in pure Cr, and are thus termed SDW paramagnons. Commensurate-diffuse scattering dominant in the paramagnetic phase of Cr is absent in Cr/sub 0.95/V/sub 0.05/. The amplitude of the SDW paramagnons in this alloy increases with temperature and their energy scale extends beyond 40 meV.

46860 Structure of iridium adatom cluster nuclei on Ir(100). Schwoebel, P.R.; Kellogg, G.L. (Sandia National Laboratories, Albuquerque, New Mexico 87185). *Physical Review Letters;* **61**: No. 5, 578-580(1 Aug 1988).

A transition from chain- to island-type structure is observed in Ir adatom cluster nuclei on Ir(100). For five or fewer adatoms the stable configuration is a nucleus in the form of a linear chain, whereas for six or more adatoms a two-dimensional island configuration is stable. This unusual transformation indicates the presence of relatively long-range interactions between the Ir adatoms.

46861 Delocalization effects at metal-semiconductor interfaces. Ludeke, R.; Jezequel, G.; Taleb-Ibrahimi, A. (IBM Thomas J. Watson Research Center, Yorktown Heights, New York 10598). *Physical Review Letters;* **61**: No. 5, 601-604(1 Aug 1988).

Changes with onset of metallic behavior in the position of an impurity-stabilized Fermi level at the GaAs-Ag interface are interpreted in a model based on delocalization of the impurity levels. The resulting energy broadening of interface states appears to be an important mechanism underlying the Schottky behavior; in particular the model obviates the need for separate donor or acceptor properties of the impurity levels.

46862 Upper critical fields of periodic and quasiperiodic Nb-Ta superlattices. Cohn, J.L.; Lin, J.J.; Lamelas, F.J.; He, H.; Clarke, R.; Uher, C. (Department of Physics, The University of Michigan, Ann Arbor, Michigan 48109). *Physical Review [Section] B: Condensed Matter;* **38**: No. 4, 2326-2332(1 Aug 1988).

Upper critical fields have been studied for two series of Nb-Ta superlattices grown by molecular-beam epitaxy with both periodic and quasiperiodic (Fibonacci sequence) layering. X-ray results are presented to characterize the nature and quality of the layering. Positive curvature in the perpendicular upper critical field (H/sub c/$_2$/sub perpendicular/), pronounced negative curvature near T/sub c/ in the parallel upper critical field (H/sub c/$_2$/sub X/), and dimensional crossover are observed in both types of samples. For quasiperiodic samples two upturns are observed in H/sub c/$_2$/sub X/ with decreasing temperature. These are shown to be associated with dimensional crossover occurring twice as the superconducting coherence length in the growth direction, ξ/sub perpendicular/, samples the two length scales, 2d/sub Nb/ and d/sub Nb/, that are present in these structures.

46863 Dimensional phase transition in superconductors with short coherence length. Guimpel, J.; Civale, L.; de la Cruz, F.; Murduck, J.M.; Schuller, I.K. (Centro Atomico Bariloche and Instituto Balseiro, 8400 Bariloche, Rio Negro, Argentina). *Physical Review [Section] B: Condensed Matter;* **38**: No. 4, 2342-2344(1 Aug 1988).

We found a novel dimensional transition in the vortex lattice of a finite-sized superconductor. The low-field dependence (with field applied parallel to the film plane) of the magnetization exhibits two maxima, which signal the transition from one to two dimensions. In one dimension the vortices line up along the film, and with increasing field their arrangement changes into a two-dimensional array due to the competition between vortex-surface and vortex-vortex repulsion. Agreement is found with no adjustable parameter calculations using a priori known surface-barrier and vortex-repulsion effects.

46864 **Scaling in the kinetics of the order-disorder transition in Ni_3Mn.** Katano, S.; Iizumi, M.; Nicklow, R.M.; Child, H.R. (Department of Physics, Japan Atomic Energy Research Institute, Tokai, Ibaraki 319-11, Japan). *Physical Review [Section] B: Condensed Matter;* **38**: No. 4, 2659-2663(1 Aug 1988).

The kinetics of the atomic ordering in Ni_3Mn has been investigated by time-resolved neutron-diffraction techniques. The results obtained show that dynamical scaling holds in the ordering process. The characteristic length grows consistently according to a power law. In addition, the growth exponent indicates a crossover, which can be attributed to the transition from coalescence of the ordered regions to migration of the domain walls. The scaling function for the structure factor is obtained and compared with the results of theories and computer simulations.

46865 **Upper critical magnetic fields of pure and thoriated UBe/sub 13/.** Schmiedeshoff, G.M.; Ma, Y.P.; Brooks, J.S.; Maple, M.B.; Fisk, Z.; Smith, J.L. (Department of Physics, Bowdoin College, Brunswick, Maine 04011). *Physical Review [Section] B: Condensed Matter;* **38**: No. 4, 2934-2937(1 Aug 1988).

We present measurements of the upper critical magnetic field H/sub c/$_2$(T) determined from the dc magnetization of polycrystalline samples of U/sub (1-//sub x//sub)/Th/sub x/Be/sub 13/ with x = 0 and x = 0.0331 and a single crystal of pure UBe/sub 13/. We find changes in slope in the H/sub c/$_2$ vs T phase diagrams of both polycrystalline samples which suggests entrance into a second superconducting phase at about T/sub c//2. A degradation of the superconducting critical field is observed in the single crystal which may be related to the absence of second-phase behavior in this sample. Our results are discussed in light of recent experimental and theoretical treatments of second-phase behavior in heavy-fermion superconductors.

46866 **(N—88-22099) Thermal expansion behavior of randomly oriented short carbon fiber reinforced copper composites.** Kuniya, K.; Arakawa, H.; Namekawa, T. (National Aeronautics and Space Administration, Washington, DC (USA)). May 1988. Translated from Nippon Kinzoku Gakkaishi (Japan), Vol. 49, No. 12, 1137-1141(1985). (NASA-TT—20175; NAS—1.77:20175). 14p. NTIS, PC A03/MF A01.

Several experiments were carried out on Cu composites with random orientation of short C fibers. The composite with random orientation of short C fibers swelled due to the elastic deformation of the fiber skeleton above 573 K. In a 3-D isotropic composite, the Cu matrix softened above 573 K and was fractured by the repulsive force of C fibers which were elastically deformed and released during heating. Swelling of the composite occurred when the fiber content was greater than or = 20 volume percent or the fiber length exceeded 0.5 millimeters. The addition of carbide-forming elements such as Ti was effective in preventing the swelling.

46867 **(N—88-22100) Reciprocating sliding wear characteristics of copper-carbon fiber composites.** Kuniya, K.; Arakawa, H.; Namekawa, T. (National Aeronautics and Space Administration, Washington, DC (USA)). May 1988. Translated from Nippon Kinzoku Gakkaishi (Japan), Vol. 50, No. 1, 119-125(1986). (NASA-TT—20176; NAS—1.77:20176). 17p. NTIS, PC A03/MF A01.

The effect of fiber orientation and alloy composition on the reciprocating sliding wear behavior of Cu-C fiber composite was studied. The wear volume was smaller than that of Cu alloys. The wear volume increased with increasing sliding load and volume fraction of C fibers above 30 volume percent. The effectiveness of fiber orientation in decreasing the wear volume was the highest for random orientation, medium in the direction perpendicular to the fiber direction, and lowest in the fiber direction. The wear volume was decreased by the addition of Sn and Zr. However, the additions did not achieve isotropic wear characteristics of the composite. Isotropic wear was obtained by the addition of C powder. Isotropic and decreased composite wear were attained by adding Zr and C powder together.

46868 **(N—88-22101) Application of copper-carbon fiber composites to power semiconductor devices.** Kuniya, K.; Arakawa, H.; Sakaue, T.; Minorikawa, H.; Akeyama, K.; Sakamoto, T. (National Aeronautics and Space Administration, Washington, DC (USA)). May 1988. Translated from Nippon Kinzoku Gakkaishi (Japan), Vol. 50, No. 6, 583-589(1986). (NASA-TT—20171; NAS—1.77:20171). 18p. NTIS, PC A03/MF A01.

Copper-carbon composite electrodes are used in a series of power semiconductor devices, i.e., resin molded diodes, button-type diodes, stud-type diodes, power modules, and integrated circuit igniter modules. The properties of these power semiconductor devices compare favorably with those conventional devices using Mo or W electrodes. In thermal fatigue tests, no degradation in the electrical and mechanical characteristics of these devices are observed. The new composite electrode with carbon fibers satisfies all of the major requirements for the electrodes in power semiconductor devices.

46869 **(N—88-22948) Thermal conductivity, electrical conductivity and specific heat of copper-carbon fiber composite.** Kuniya, K.; Arakawa, H.; Kanai, T.; Chiba, A. (National Aeronautics and Space Administration, Washington, DC (USA)). May 1988. Translated from Nippon Kinzoki Gakkaishi (Japan), Vol. 49, No. 10, 906-912(1985). (NASA-TT—20172; NAS—1.77:20172). 18p. NTIS, PC A03/MF A01.

A new material of copper/carbon fiber composite is developed which retains the properties of copper, i.e., its excellent electrical and thermal conductivity, and the property of carbon, i.e., a small thermal expansion coefficient. These properties of the composite are adjustable within a certain range by changing the volume and/or the orientation of the carbon fibers. The effects of carbon fiber volume and arrangement changes on the thermal and electrical conductivity, and specific heat of the composite are studied. Results obtained are as follows: the thermal and electrical conductivity of the composite decrease as the volume of the carbon fiber increases, and were influenced by the fiber orientation. The results are predictable from a careful application of the rule of mixtures for composites. The specific heat of the composite was dependent, not on fiber orientation, but on fiber volume. In the thermal fatigue tests, no degradation in the electrical conductivity of this composite was observed.

46870 **(N—88-22979) Question on the measurement of the metal work function in al electron spectrometer by the secondary-electron emission threshold method.** Alov, N.V.; Dadayan, K.A. (National Aeronautics and Space Administration, Washington, DC (USA)). Apr 1988. Translated from Pisma Zhurnal Tekhnicheskai Fiziki (USSR), Vol. 13, No. 5, 290-293(13 Mar 1987). (NASA-TT—20190; NAS—1.77:20190). 7p. NTIS, PC A02/MF A01.

The feasibility of measuring metal work functions using the secondary emission threshold method and an electron spectrometer is demonstrated. Measurements are reported for Nb, Mo, Ta, and W bombarded by Ar(+) ions.

46871 **(N—88-22104) Joints in fiber-reinforced aluminum alloys.** Gerber, K.; Vanrensen, E. (National Aeronautics and Space Administration, Washington, DC (USA)). Apr 1988. Translated into English of Fuegen Faserverstaerkter Aluminiumlegierungen presented at the 3rd Composites Meeting, 1974 p 359-376. (NASA-TT—20160; NAS—1.77:20160; CONF-7403112—). 22p. NTIS, PC A03/MF A01.

From Joints in fiber-reinforced aluminum alloys meeting; Konstanz, F.R. Germany (28 Mar 1974).

Problems of joining involving structural components made of aluminum alloys with boron-fiber reinforcements are discussed, giving attention to a diffusion-welding process. The tension characteristics and weight factors in the case of various types of welded joints are considered. Diffusion-welding equipment used in the experimental investigation is described. The strength characteristics obtained in various cases of weld and component design are examined, taking into account static and dynamic stresses.

46872 Reaction of water vapor and oxygen with liquid uranium. Balooch, M.; Orlander, D.R.; Siekhaus, W.J. (Lawrence Berkeley Lab., CA (USA)). *Oxidation of Metals;* 28: No. 3-4, 195-211(Oct 1987). Contract AC03-76SF00098.

The reactions of water vapor and oxygen with liquid uranium were studied by modulated molecular-beam mass spectrometric methods. Equivalent pressures of the reactant fluxes on the surface ranged from 6×10^{-8} to 2×10^{-4} torr. Temperatures up to 1570 K were investigated. The metal surface was kept clean during reaction by mechanical removal of the oxide formed with a tungsten needle. For the clean liquid uranium surface, a water reaction probability of ~ 0.4 was deduced both from measurement of the reaction-product hydrogen signal and by the temperature dependence of the scattered reactant signal. Based solely on the latter measure, a reaction probability of 0.6 was estimated for oxygen. The reaction probabilities on the clean surface were temperature-independent. They decreased as the coverage of the surface by islands of oxide increased and, for water, appeared to approach a value of 0.08 for a surface completely covered with an oxide estimated to be 500 A thick. Bombardment of the surface during reaction with argon ions produced an increase in the reactivity on solid uranium but had a negligible effect on the reaction probability for the liquid.

46873 Numerical analysis of cellular solidification microstructures. Brown, R.A.; Ramprasad, N.; Bennett, M.J. (Dept. of Chemical Engineering and Materials Processing Center, Massachusetts Institute of Technology, Cambridge, MA (US)). pp 295-333 of Supercomputer research in chemistry and chemical engineering. Jensen, K.F.; Truhlar, D.G. Washington, DC; American Chemical Society (1987). (CONF-8703229—).

From Symposium on supercomputer research in chemistry and chemical engineering; Minneapolis, MN, USA (16 Mar 1987).

Large-scale numerical calculations are used to simulate the formation of cellular microstructures during directional solidification of a binary alloy. The analyses are based on finite-element methods developed especially for solving the free- and moving-boundary problems that describe the solute field in the melt and solid and the melt/solid interface shape in the Solutal Model of microscopic solidification. Calculations are reported for individual cells that show the transitions from steady-state solidification of shallow cells near the onset of morphological instability to deep cells separated by narrow grooves as seen in experiments. Simulations with multiple cells show the importance of nonlinear interactions between shapes with resonant spatial structures in determining the time-dependent dynamics of large collections of cells. The results of cellular dynamics calculations for multiple cells show the possibility of long time-scale time-periodic and quasi-periodic interactions.

46874 The thermal stability of a refined dispersion of erbia particles in rapidly solidified Ti-Er and Ti-Al-Er alloys. Lofvander, J.P.A.; Court, S.A.; Kirchheim, R.; Konitzer, D.G.; Fraser, H.L. (Univ. of Illinois, Urbana, IL (US)). pp 231-242 of Proceedings of structural metals by rapid solidification. Froes, F.H.; Savage, S.J. Metals Park, OH; American Society for Metals (1987). (CONF-8610375—).

From Symposium on enhanced properties in structural metals via rapid solidification; Orlando, FL, USA (6 Oct 1986).

The present study has determined the thermal stability of dispersions of erbia particles produced by rapid solidification, both from a theoretical viewpoint and by experiment. Ti-Er alloys and a Ti-8.4Al (at.%) alloy have been used, as well as compositions corresponding to the intermetallic compound Ti/sub 3/Al. It has been found that if the dispersion of rare-earth oxides is formed and heat-treated below the α-transus, the particles are very stable, and this agrees well with prediction. If the samples are heat-treated into a two-phase ($\alpha+B$) region, or one comprising entirely of B, then the increased solubility and diffusivity of Er and O along migrating α/B interfaces gives rise to accelerated Ostwald ripening resulting in large, coarsened oxide particles. It was predicted that the thermal stability of the particles would be enhanced by an increased concentration of oxygen; thus, the greatest stability was shown to correspond to there being an excess amount of oxygen over that required to form the oxide, and this prediction was confirmed by experiment.

46875 Processing and properties of powder metallurgy Ni/sub 3/ Al-Cr-Zr-B for use in oxidizing environments. Sikka, V.K.; Liu, C.T.; Loria, E.A. (Metals and Ceramics Div., Oak Ridge National Lab., Oak Ridge, TN (US)). pp 417-428 of Proceedings of structural metals by rapid solidification. Froes, F.H.; Savage, S.J. Metals Park, OH; American Society for Metals (1987). (CONF-8610375—).

From Symposium on enhanced properties in structural metals via rapid solidification; Orlando, FL, USA (6 Oct 1986).

The addition of Cr to B-doped Ni/sub 3/Al in small ingots used for alloy development alleviates dynamic embrittlement, as exemplified by low tensile elongation and intergranular fracture, upon testing in air at 600°C. Powder metallurgy (PM) technology is advantageous to properties due to improved microstructure from rapid solidification, and its effectiveness was studied in the up-scale production of four heats of this intermetallic compound with 8 Cr, 0.8 or 1.8 Zr, and 0.02 B (wt %). Sheet derived from a cold-rolling and annealing sequence on extruded product had a satisfactory level of ductility in tensile tests conducted in air within the critical 400 to 800°C range. The processing parameters for hot workability of the PM product were established via a number of different strain rate tensile tests in air at temperatures up to 1100°C. Superplastic behavior presented the opportunity for fabrication of a forged shape by hot isothermal forging. Preliminary forging of cylinders cut from the extruded bars revealed no peripheral cracking in 60% compression tests at strain rates of 0.1 to 0.5/min at 1100°C. Successful isothermal forging of a prototype turbine disk directly from extruded bar stock in a closed die at 1100°C and strain rate of 0.5/min was demonstrated, and the microstructure and mechanical properties were at least equal to those of PM sheet and bar products.

46876 Tensile properties of extrusion consolidated type 304 SS rapidly solidified powders. Flinn, J.E.; Korth, G.E.; Wright, R.N. (Idaho National and Engineering Lab., EG and G Idaho, Inc., Idaho Falls, ID (US)). pp 459-468 of Proceedings of structural metals by rapid solidification. Froes, F.H.; Savage, S.J. Metals Park, OH; American Society for Metals (1987). (CONF-8610375—).

From Symposium on enhanced properties in structural metals via rapid solidification; Orlando, FL, USA (6 Oct 1986).

Rapidly solidified Type 304 Ss powders prepared by centrifugal atomization (CA) using helium as a quench gas and having a dendritic microstructure were hot extruded, resulting in fully consolidated bars with a recrystallized fine grain size. The extruded bar as well as the powder contained 8 appm of entrapped helium acquired during powder processing. Prior to tensile testing, the specimens were given various preconditioning heat treatments (PCHTs). The tests were conducted in air over a temperature range of 24 to 800°C at a strain rate of approximately 10/sup -4//s. The tensile properties of the centrifugally atomized (CA) 304 SS extruded powders were compared to those of an ingot metallurgy (I/M) Type 304 SS material with a similar chemistry. The tensile strengths and reductions in area were superior for the rapidly solidified CA 304 SS extruded powders compared to the I/M material, but uniform and total elongations were slightly lower. There were no obvious helium influences associated with the ductilities, e.g., embrittlement. The preconditioning heat treatments for the CA 304 SS extruded powder specimens had a significant influence on the strength properties. Strengthening mechanisms are discussed, including grain size, entrapped helium influences, and apparent carbide effects.

46877 Thermal and mechanical behavior of a rapidly solidified 9% Cr alternative to type 304 stainless steel. Korth, G.E.; Wright, R.N.; Flinn, J.E. (Idaho National Engineering Lab., EG and G Idaho, Inc., Idaho Falls, ID (US)). pp 469 of Proceedings of structural metals by rapid solidification. Froes, F.H.; Savage, S.J. Metals Park, OH; American Society for Metals (1987). (CONF-8610375—).

From Symposium on enhanced properties in structural metals via rapid solidification; Orlando, FL, USA (6 Oct 1986).

Rapidly solidified powders of a 9% Cr version of Type 304 SS were produced by centrifugal atomization (CA) and consolidated by hot extrusion into bar or hot isostatically pressed into plates. Characterization assessments were performed on both the powder and consolidated products. The powders exhibited a dendritic microstructure and were found to be 90% bcc which was retained during consolidation. High temperature heat treatments were performed on material that had been hot extruded, hot isostatically pressed, and hot isostatically pressed plus 50% cold worked. The grain sizes were comparable for all three conditions and marked grain growth resistance was observed even after 1 h at 1200%C. Tensile and creep properties were determined for the CA 9% Cr alloy and these results were compared with austenitic CA Type 304 SS extruded powder material. The CA 9% Cr alloy displayed much higher tensile strengths but reduced ductility and creep-rupture properties were observed.

46878 Inhalation hazards from machining beryllium metal. Hoover, M.D.; Finch, G.L.; Mewhinney, J.A.; Eidson, A.F. *Transactions of the American Nuclear Society;* 55: 86-87(1987). (CONF-8711195—).

From American Nuclear Society winter meeting; Los Angeles, CA, USA (15 Nov 1987).

Beryllium metal has special nuclear and structural properties that make it useful for applications in fission and fusion reactor designs. Unfortunately, concerns for its toxicity have made designers wary of using beryllium metal. The work being reported here was undertaken to characterize the aerosols produced by two very common operations performed during preparation or modification of components for use in reactor systems: sawing and milling of beryllium metal. The study also covered beryllium metal alloys to allow comparison. Information from this study is to enable better assessments of the risk of using beryllium metal in reactor designs.

46879 Ion-assisted deposition of metal and ceramic coatings. Legg, K.O. *Transactions of the American Nuclear Society;* 55: 262(1987). (CONF-8711195—).

From American Nuclear Society winter meeting; Los Angeles, CA, USA (15 Nov 1987).

The use of ion beams to assist in the deposition of coatings is a rapidly developing technology. Various forms of plasma-aided deposition have been used for some time, and in many ways ion-assisted deposition can be viewed as a more controlled form of this type of process. It does, however, differ substantially in the energies and beam currents employed and hence in some of the mechanisms. A variety of ion-assisted deposition processes are being used increasingly to obtain coatings that are highly adherent to almost any substrate without the need for heat during deposition. Furthermore, the properties of the coatings can be tailored to meet particularly stringent requirements. The generic term ion-assisted deposition (or coating) (IAD or IAC) describes any coating process in which an ion beam is used to improve the properties of the coating; specific processes are often described in other terms. The term ion-beam assisted deposition describes those IAC processes in which the substrate is irradiated with an ion beam during coating deposition. When reactive species are used, the method is known as reactive ion beam assisted deposition. This paper describes the underlying physical mechanisms of these various types of IAD, both for producing adherent coatings on various types of substrate and for tailoring the coatings for better surface properties.

46880 Ion implantation of Ti + C to reduce friction and wear on steel surfaces. Follstaedt, D.M.; Pope, L.E. (Sandia National Lab., Albuquerque, NM (USA)). *Transactions of the American Nuclear Society;* 55: 262-264(1987). (CONF-8711195—).

From American Nuclear Society winter meeting; Los Angeles, CA, USA (15 Nov 1987).

Within the last decade, ion implantation has been investigated for use in improving the surface-related mechanical properties of metal alloys. The treatment has improved the performance of device components and is now being used commercially in selected applications. A notable accomplishment is the reduction of wear by nitrogen implantation of many steel components used in mild wear applications. Another treatment receiving intensive investigation is the implantation of Ti + C into steels. This procedure not only reduces wear of steels, but has two important benefits beyond those obtained with nitrogen implantation: (a) friction is also reduced and (b) the reductions extend to hard bearing steels. Benefits have been obtained for all ferrous materials examined with unlubricated pin-on-disk testing in air, which range from soft austenitic (Type 304) to hard martensitic (Types 52100 and 440C) steels. The reductions in friction and wear obtained with this treatment are due to the amorphous surface layer. Examination with TEM of wear tracks from tests exhibiting the reductions show that not only is implanted titanium still present, but the amorphous layer is intact across the track.

46881 Near-surface segregation during ion-beam modification. Rehn, L.E. (Argonne National Lab., IL (USA)). *Transactions of the American Nuclear Society;* 55: 264-265(1987). (CONF-8711195—).

From American Nuclear Society winter meeting; Los Angeles, CA, USA (15 Nov 1987).

The thermodynamic basis for equilibrium surface segregation was formulated by Gibbs in the previous century. Several additional, nonequilibrium driving forces for segregation manifest themselves during ion irradiation. Because large numbers of excess point defects are created, one effect of irradiation is simply to enhance the rate at which Gibbsian surface segregation approaches equilibrium. In addition to this radiation-enhanced diffusion (RED), there exist at least four other kinetic effects that can alter the near-surface composition of an alloy during irradiation: implantation, preferential sputtering, displacement mixing, and radiation-induced segregation (RIS). The altered layer produced in the near-surface, ion-implanted region is driven to substantially greater depths at elevated temperatures by RED and RIS. Theoretical modeling of the compositional changes beneath the implanted layer is simplified because only these two processes operate there. Actual RED coefficients have been extracted from measurements in this region. The compositional change due to RIS has also been observed at great depths in the specimen. Radiation-induced segregation is significantly more effective than RED at producing compositional changes very deep in the target. This greater effectiveness may prove beneficial in practical applications of ion-beam surface modification.

46882 The low-temperature neutron irradiation facility at ORNL. Kerchner, H.R.; Coltman, R.R. Jr.; Klabunde, C.E.; Young, F.W. Jr. (Solid State Div., Oak Ridge National Lab., Oak Ridge, TN (US)). pp 701-704 of Influence of radiation on material properties: ASTM 13th international symposium (Part II). Garner, F.A.; Henager, C.H.; Igata, N. Philadelphia, PA; ASTM (1987). (CONF-860605—).

From 13. international symposium on the effects of radiation on materials; Seattle, WA, USA (23 Jun 1986).

The Low-Temperature Neutron Irradiation Facility (LTNIF) is now opening at Oak Ridge National Laboratory. The facility provides high radiation intensities and special environmental and testing conditions for qualified experiments at no cost to users. A general description and major specifications of the LTNIF are presented along with the results of performance tests. In addition, the hardware and other considerations required to perform experiments in the LTNIF are described.

46883 Recent research in neutron dosimetry and damage analysis for materials irradiations. Greenwood, L.R. (Argonne National Lab., 9700 South Cass Ave., Argonne, IL (US)). pp 743-749 of Influence of radiation on material properties: ASTM 13th international symposium (Part II). Garner, F.A.; Henager, C.H.; Igata, N. Philadelphia, PA; ASTM (1987). (CONF-860605—).

From 13. international symposium on the effects of radiation on materials; Seattle, WA, USA (23 Jun 1986).

Neutron fleuence measurements and damage calculations are being routinely performed for fusion materials irradiations in fission reactors, at 14 MeV sources, and at high-energy accelerator neutron sources. Neutron activation cross sections are being developed for dosimetry at fission reactors, fusion reactors, and high-energy accelerator neutron sources. Integral and differential measurements are being combined to determine new cross sections and to adjust discrepant data. These data are needed to adequately define the neutron exposure and radiation damage in materials. The production of long-lived radioisotopes is being measure at 14 MeV for fusion reactors and reactions are being developed for plasma diagnostics. At high energies, spallation cross sections are being measured for dosimetry and damage analysis at accelerator neutron sources. Helium production cross sections are being tested and a new thermal helium effect has been discovered in copper similar to the well known effect in nickel. Damage calculations are routinely provided by the SPECTER computer code and new calculations are being performed to extend our damage cross sections to higher energies for accelerator neutron sources and to include alloys and compounds.

46884 **Additional measurements of the radiation environment at the Los Alamos Spallation Radiation Effects Facility at LAMPF.** Davidson, D.R.; Reedy, R.C.; Greenwood, L.R.; Sommer, W.F.; Wechsler, M.S. (Los Alamos National Lab., Los Alamos, NM (US)). pp 730-742 of Influence of radiation on material properties: ASTM 13th international symposium (Part II). Garner, F.A.; Henager, C.H.; Igata, N. Philadelphia, PA; ASTM (1987). (CONF-860605—).

From 13. international symposium on the effects of radiation on materials; Seattle, WA, USA (23 Jun 1986).

Foil activation dosimetry experiments were conducted in a "rabbit" system at the completed Los Alamos Spallation Effects Facility(LASREF). The "rabbit" system contains four test tubes spaced radially outward 0.12, 0.18, 0.27, and 0.38 m off beam centerline. Foils were irradiated for 3 to 62 h to measure the neutron flux and energy spectrum radially from beam centerline, along the beamline, and the effect of isotope production (IP) target loadings on the neutron flux in the neutron irradiation locations. Irradiations showed a decrease in the radial flux by a factor of 6 in 0.15 m of iron outside the IP targets. An enhancement was seen in the 24-keV energy region outside 0.15m. There was little difference in the shape of the spectra outside the IP targets and the beam stop with the exception of the high energy tail (energies above 20 MeV). The decrease in the high energy tail outside the beam stop is due to the degradation of the energy of the proton beam in the IP targets. Irradiations outside the beam stop with zero and eight IP targets gave the same spectral shape with the exception of the high energy tail. The magnitude of the integral flux decreased by a factor of two when eight IP targets were present. Irradiations with five "rabbits" stacked on top of each other showed no difference in the integral flux below, on and above beam centerline.

46885 **Operating experience at the Los Alamos Spallation Radiation Effects Facility at LAMPF.** Sommer, W.F.; Lohmann, W.; Graf, K.; Taylor, I.K.; Chavez, R.M. (Los Alamos National Lab., Los Alamos, NM (US)). pp 718-729 of Influence of radiation on material properties: ASTM 13th international symposium (Part II). Garner, F.A.; Henager, C.H.; Igata, N. Philadelphia, PA; ASTM (1987). (CONF-860605—).

From 13. international symposium on the effects of radiation on materials; Seattle, WA, USA (23 Jun 1986).

Operation of a new irradiation facility at the beam stop (Target Station A-6) at the Clinton P. Anderson Los Alamos Meson Physics Facility(LAMPF)began in May 1985. The facility is now fully operational. A closed-loop water system, a closed-loop helium system, remote handling procedure for activated materials, experiment change-out procedures, and experiment control equipment are all in place. Experience dictated a change in irradiation capsules from a system that used metal seals to a system that is completely welded. The seals were found to be unreliable and difficult to replace by remote means. Several materials have been irradiated in the direct 760-MeV proton beam. Material property changes as well as a helium production in a variety of materials are being investigated. A special sample holder that ca accommodate transmission electron microscopy(TEM)specimens, isolate them from the cooling medium, maintain fixed temperature, and retain essentially a stress-free state has been developed. Remote handling retrieval of these specimens is being developed. Activation foil measurements are being made to determine the secondary particle flux and spectrum (charged particles and neutrons) that result from interaction of the direct proton beam with targets at the beam stop.

46886 **A statistical analysis of fracture toughness of irradiated low-alloy steel plate and welds.** McGowan, J.J.; Nanstad, R.K. (Virginia Military Institute, Dept. of Engineering, Lexington, VA (US)). pp 569-592 of Influence of radiation on material properties: ASTM 13th international symposium (Part II). Garner, F.A.; Henager, C.H.; Igata, N. Philadelphia, PA; ASTM (1987). (CONF-860605—).

From 13. international symposium on the effects of radiation on materials; Seattle, WA, USA (23 Jun 1986).

Studies of the effects of neutron irradiation on fracture toughness properties of steels have generally included a minimum number of tests for each material condition. The present study attempts to apply statistical analyses with multiple testing at selected temperatures to assess the accuracy and reliability of the results. Fracture toughness test specimens were irradiated in the Bulk Shielding Reactor at Oak Ridge National Laboratory at 288°C to target neutron fluences of 2 x 10/sup 23/ n/m/sup 2/ (>1 MeV). The materials were ASTM A533 Grade B Class 1 plate (HSST Plate 02) and four submerged-arc welds representing current nuclear pressure vessel fabrication practice. Both unirradiated and irradiated specimens were tested by two separate laboratories, and multiple tests were conducted at selected temperatures. Statistical analyses permitted determination of material and test variability and an interlaboratory comparison. Behavior in both the transition and upper-shelf regions was studied.

46887 **Damage rate and spectrum effects in ferritic steel ΔNDTT data.** Simons, R.L. (Hanford Engineering Development Lab., P.O. Box 1970, Richland, WA (US)). pp 535-551 of Influence of radiation on material properties: ASTM 13th international symposium (Part II). Garner, F.A.; Henager, C.H.; Igata, N. Philadelphia, PA; ASTM (1987). (CONF-860605—).

From 13. international symposium on the effects of radiation on materials; Seattle, WA, USA (23 Jun 1986).

A model was developed for irradiation-induced hardening in pressure vessel steels by cascade-induced nucleation and free defect diffusion of copper to coherent copper clusters. The model was used as a functional framework for fitting data on macroscopic property change (ΔNDTT) as a function of damage dose and dose rate. Several defect cross sections having different neutron energy dependences were tried. The cross section for Frenkel pair production, based on resistivity measurements at 4 K, was found to give a comparable or slightly better fit to the data than dpa. Damage rate is an important parameter to consider in correlation of ΔNDTT data, and damage rate can affect the nucleation as well as the growth of the copper precipitation.

46888 **Trend curve data development and testing.** McElroy, W.N.; Gold, R.; Simons, R.L.; Roberts, J.H. (Westinghouse Hanford Co., Hanford Engineering Development Lab., Richland, WA (US)). pp 505-534 of Influence of radiation on material properties: ASTM 13th international symposium (Part II). Garner, F.A.; Henager, C.H.; Igata, N. Philadelphia, PA; ASTM (1987). (CONF-860605—).

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Existing trend curves do not account for previous and more recently observed test and power reactor flux-level, thermal neutron and γ-ray field-induced effects. Any agreement between measured data and trend curve predictions that does not adequately represent the important neutron environmental and temperature effects as well as the microstructural damage processes, therefore, could be fortuitous. Empirically derived end-of-life (EOL) and life-extension-range (LER) trend curves are presented and discussed in this paper for high temperature [—288°C (550°F)] irradiation of two weld, two plate, and two forging pressure vessel (PV) steels and low-temperature [—60°C (140°F)] irradiation of one support structure-type steel. Preliminary results of a comprehensive study of the effects of

environmental variables (neutron spectrum, exposure, exposure rate, and the thermal and γ-ray fluxes associated with surveillance capsules and PV through-wall gradients) were used to develop these trend curves. Pressurized water reactor (PWR) and boiling water reactor (BWR) plant-specific results together with those of the Poolside Facility (PSF) of the Oak Ridge Research Reactor (ORR) at the Oak Ridge National Laboratory (ORNL) and other research reactor experiments support the existence of a significant material-dependent flux-level effect for PV and support structure steels; that is, a steel may show a decrease, an increase, or no change in the measured Charpy shift with changes in flux-level. Further, the actual behavior of a material can change significantly as a function of neutron exposure; also, thermal neutron and γ-ray effects can contribute to observed changes in property, especially near steel-water interface positions with high thermal-to-fast-neutron ratios.

46889 Tensile and fracture properties of EBR-II-irradiated V-15Cr-5Ti containing helium. Grossbeck, M.L.; Horak, J.A. (Metals and Ceramics Div., Oak Ridge National Lab., P.O. Box X, Oak Ridge, TN (US)). pp 291-309 of Influence of radiation on material properties: ASTM 13th international symposium (Part II). Garner, F.A.; Henager, C.H.; Igata, N. Philadelphia, PA; ASTM (1987). (CONF-860605—).

From 13. international symposium on the effects of radiation on materials; Seattle, WA, USA (23 Jun 1986).

The alloy V-15Cr-5Ti was cyclotron-implanted with 80 appm He and subsequently irradiated in the Experimental Breeder Reactor (EBR-II) to 30 displacements per atom (dpa). The same alloy was also irradiated in the 10, 20, and 30% cold-worked conditions. Irradiation temperatures ranged from 400 to 700°C. No significant effects of helium on mechanical properties were found in this temperature range although the neutron irradiation shifted the temperature of transition from cleavage to ductile fracture to about 625°C. Ten percent cold work was found to have a beneficial effect in reducing the tendency for cleavage fracture following irradiation, but high levels (20%) were observed to reduce ductility. Still higher levels (30%) improved ductility by inducing recovery during the elevated-temperature irradiation. Swelling was found to be negligible, but precipitates - titanium oxides or carbonitrides - contained substantial cavities.

46890 The effect of neutron irradiation on the tensile properties and microstructure of several vanadium alloys. Braski, D.N. (Metals and Ceramics Div., Oak Ridge National Lab., Oak Ridge, TN (US)). pp 271-290 of Influence of radiation on material properties: ASTM 13th international symposium (Part II). Garner, F.A.; Henager, C.H.; Igata, N. Philadelphia, PA; ASTM (1987). (CONF-860605—).

From 13. international symposium on the effects of radiation on materials; Seattle, WA, USA (23 Jun 1986).

Specimens of V-15Cr-5Ti, VANSTAR-7, and V-3Ti-1Si were encapsulated in molybdenum alloy tubes containing /sup 7/Li to prevent interstitial pickup and irradiated in the Fast Flux Test Facility (FFTF), using Materials Open Test Assembly (MOTA) experiments, to a damage level of 40 displacements per atom (dpa). The irradiation temperatures were 420, 520, and 600°C. For a better simulation of fusion reactor conditions, helium was preimplanted in some specimens using a modified version of the "tritium trick." The V-15Cr-5Ti alloy was most susceptible to irradiation hardening and helium embrittlement, followed by VANSTAR-7, and V-3Ti-1Si. VANSTAR-7 exhibited a relatively high maximum void swelling of —6% at 520°C while V-15Cr-5Ti and V-3Ti-1Si had values of <0.3% at all three temperatures. The V-3Ti-1Si clearly outperformed the other two vanadium alloys in resisting the effects of neutron irradiation.

46891 Mechanical properties and fracture behavior of 20% cold-worked 316 stainless steel irradiated to very high neutron exposures. Hamilton, M.L.; Huang, F.H.; Yang, W.J.S.; Garner, F.A. (Hanford Engineering Development Lab., Richland, WA (US)). pp 245-270 of Influence of radiation on material properties: ASTM 13th international symposium (Part II). Garner, F.A.; Henager, C.H.; Igata, N. Philadelphia, PA; ASTM (1987). (CONF-860605—).

From 13. international symposium on the effects of radiation on materials; Seattle, WA, USA (23 Jun 1986).

Stainless steels irradiated in EBR-II at temperatures in the range 380 to 500°C tend to exhibit saturation of mechanical properties at relatively low fluence levels. At fluences on the order of 13 to 15 x 10/sup 22/ n/cm/sup 2/ (E > 0.1 MeV), however, there is a rapid increase in hardness just after the onset of void swelling. The hardness increase is not attributed just to the voids themselves but rather to an indirect effect of voids on nickel depletion in the alloy matrix. The strong dependence of stacking fault energy on nickel and chromium content and particularly on deformation temperature combine to promote extensive stress-induced formation of ε-martensite at room temperature. This leads to a very brittle failure mode characterized as quasi-cleavage. At higher deformation temperatures it leads to a failure mode designated as channel fracture.

46892 Radiation effects on the micromechanics of fatigue crack initiation. Naughton, T.D.; Ghoniem, N.M.; Lin, T.H. (TRW Inc., Mail Station 134/9816, One Space Park, Redondo Beach, CA (US)). pp 223-238 of Influence of radiation on material properties: ASTM 13th international symposium (Part II). Garner, F.A.; Henager, C.H.; Igata, N. Philadelphia, PA; ASTM (1987). (CONF-860605—).

From 13. international symposium on the effects of radiation on materials; Seattle, WA, USA (23 Jun 1986).

A micromechanical model is employed to investigate parameters that affect the rate of local plastic strain in and around persistent slip bands in cyclically loaded metals. The model utilizes a solution of the stress field in a semi-infinite elastic-plastic medium under generalized plane deformation. By following the evolution of the stress field, a natural gating mechanism is observed to produce regions of localized deformation. The regions of local deformation develop into extrusions and intrusions that are responsible for the formation of fatigue cracks. By coupling this micromechanical model with an empirical correlation developed to predict the increase in critical shear stress as a function of fluence and temperature, an investigation of radiation effects of fatigue crack initiation is carried out. It is determined that longer fusion reactor burn times and lower operating temperatures inhibit the crack initiation rate. Because of irradiation induced-hardening, increases in the fatigue limit are predicted for long reactor burn times (>10/sup 3/s) and low operating temperatures (<300°C). Irradiation is found to increase the number of cycles required to obtain a failure strain at low temperatures and high-cycle fatigue conditions.

46893 Effect of cold work on tensile behavior of irradiated Type 316 stainless steel. Kluch, R.L.; Maziasz, P.J. (Metals and Ceramics Div., Oak Ridge National Lab., Oak Ridge, TN (US)). pp 207-222 of Influence of radiation on material properties: ASTM 13th international symposium (Part II). Garner, F.A.; Henager, C.H.; Igata, N. Philadelphia, PA; ASTM (1987). (CONF-860605—).

From 13. international symposium on the effects of radiation on materials; Seattle, WA, USA (23 Jun 1986).

The effect of various levels of cold work on the tensile behavior of Type 316 stainless steel was investigated. Tensile specimens were irradiated in the Oak Ridge Research Reactor (ORR) at 250, 290, 450, and 500°C to produce a displacement damage of —5 displacements per atom (dpa) and 40 atomic ppm He. Irradiation at 250 and 290°C caused an increase in yield stress and ultimate tensile strength and a decrease in ductility relative to unaged and thermally aged controls. The changes were greatest for the 20%-cold-worked steel and lowest for the 50%-cold-worked steel. Irradiation at 450°C caused a slight decrease in strength for all cold-worked conditions relative to the aged material. A large decrease was observed at 500°C, with the largest decrease occurring for the 50%-cold-worked specimen. No bubble, void, or precipitate formation was observed for specimens examined by transmission electron microscopy (TEM). The irradiation hardening was correlated with Frank-loop and "black-dot" damage. A strength decrease at 500°C was correlated with dislocation network recovery. Comparison of tensile and TEM results from ORR-irradiated steel with those from steels irradiated in the High Flux Isotope Reactor and the Experimental Breeder Reactor indicated consistent strength and microstructure changes.

46894 **Post-irradiation fracture properties of precipitation-strengthened alloy D21.** Huang, F.H. (Westinghouse Hanford Co., P.O. Box 1970, Richland, WA (US)). pp 141-150 of Influence of radiation on material properties: ASTM 13th international symposium (Part II). Garner, F.A.; Henager, C.H.; Igata, N. Philadelphia, PA; ASTM (1987). (CONF-860605—).

From 13. international symposium on the effects of radiation on materials; Seattle, WA, USA (23 Jun 1986).

The precipitation strengthened alloys have the potential for use in fuel cladding and duct applications for liquid metal reactors due to their high strength and low swelling rate. Unfortunately, these high strength alloys tend to exhibit poor fracture toughness, and the effects of neutron irradiation on the fracture properties of the material are of concern. Compact tension specimens of alloy D21 were irradiated in the Experimental Breeder Reactor II to a fluence of 2.7 x 10/sup 22/ neutrons (n)/cm/sup 2/ (E > 0.1 MeV) at 425, 500, 550, and 600°C. Fracture toughness tests on these specimens were performed using electric potential techniques at temperatures ranging from 205 to 425°C. The material exhibited low post-irradiation fracture toughness which increased with either increasing test or irradiation temperature. The tearing modulus, however, increased with increasing irradiation temperature but decreased with increasing test temperature. Results were analyzed using the J-integral approach. The fracture toughness of irradiated D21 was evaluated essentially following the procedure recommended in ASTM Test Method E813. It was found that the data elimination limits illustrated in E813 were too large for the specimens tested, although the thickness criterion was satisfied. The precautions needed to determine J/sub Ic/ based on a reduced data qualification range were discussed.

46895 **Tensile properties of several 800 MeV proton-irradiated bcc metals and alloys.** Brown, R.D.; Wechsler, M.S.; Tschalar, C. (Los Alamos National Lab., P.O. Box 1663, MSH840, Los Alamos, NM (US)). pp 131-140 of Influence of radiation on material properties: ASTM 13th international symposium (Part II). Garner, F.A.; Henager, C.H.; Igata, N. Philadelphia, PA; ASTM (1987). (CONF-860605—).

From 13. international symposium on the effects of radiation on materials; Seattle, WA, USA (23 Jun 1986).

A spallation neutron source for the 600-MeV proton accelerator facility at the Swiss Institute for Nuclear Research (SIN) consists of a vertical cylinder filled with molten Pb-Bi. The proton beam enters the cylinder, passing upward through a window in contact with the Pb-Bi eutectic liquid that must retain reasonable strength and ductility upon irradiation at about 673 K to fluence of about 1 x 10/sup 25/ protons/m/sup 2/. Investigations are underway at the 800-MeV proton accelerator at the Los Alamos Meson Physica Facility (LAMPF) to test the performance of candidate SIN window materials under appropriate conditions of temperature, irradiation, and environment. Based on considerations of chemical compatibility with molten Pb-Bi, as well as interest in identifying fundamental radiation damage mechanisms, Fe, Ta, Fe-2.25Cr-1Mo, and Fe-12Cr-1Mo(HT-9) were chosen as candidate materials. Sheet tensile samples, 0.5-mm thick, of the four materials were fabricated and heat treated. The samples were sealed inside capsules containing Pb-Bi and were proton-irradiated at LAMPF to two fluences, 4.8 and 54 x 10/sup 23/ p/m/sup 2/. The beam current was approximately equal to the 1 mA anticipated for the upgraded SIN accelerator. The power deposited by the proton beam in the capsules was sufficient to maintain sample temperatures of about 673 K. Post-irradiation tensile tests were conducted at room temperature at a strain rate of 9 x 10/sup -4/s/sup -1/. The yield and ultimate strengths increased upon irradiation in all materials, while the ductility decreased, as indicated by the uniform strain. The pure metals, Ta and Fe, exhibited the greatest radiation hardening and embrittlement. The HT-9 alloy showed the smallest changes in strength and ductility. The increase in strength following irradiation is discussed in terms of a dispersed-barrier hardening model, for which the barrier sizes and formation cross sections are calculated.

46896 **The ductile-to-brittle transition behavior of martensitic steels neutron irradiated to 26 dpa.** Hu, W.L.; Gelles, D.S. (Westinghouse Hanford Co., P.O. Box 1970, Richland, WA (US)). pp 83-97 of Influence of radiation on material properties: ASTM 13th international symposium (Part II). Garner, F.A.; Henager, C.H.; Igata, N. Philadelphia, PA; ASTM (1987). (CONF-860605—).

From 13. international symposium on the effects of radiation on materials; Seattle, WA, USA (23 Jun 1986).

Charpy impact tests were conducted on specimens made of HT-9 and 9CR-1Mo in various heat treatment conditions that were irradiated in EBR-II to 26 dpa at 390 to 500°C. The results are compared with previous results on specimens irradiated to 13 dpa. HT-9 base metal irradiated at low temperatures showed a small additional increase in ductile brittle transition temperature and a decrease in upper shelf energy from 13 to 26 dpa. No fluence effect was observed in 9Cr-1Mo base metal. The 9Cr-1Mo weldment showed degraded ductile-to-brittle transition temperature (DBTT) but improved upper shelf energy (USE) response compared to base metal, contrary to previous findings on HT-9. Significant differences were observed in HT-9 base metal between mill annealed material and normalized and tempered material. The highest DBTT for HT-9 alloys was 50°C higher than for the worst case in 9Cr-1Mo alloys. Fractography and hardness measurements were also obtained. Significant differences in fracture appearance were observed in different product forms, although no dependence on fluence was observed. Failure was controlled by the preirradiation microstructure.

46897 **Light-ion irradiation creep and hardening of model ferritic alloys.** Henager, C.H. Jr.; Simonen, E.P. Jr. (Pacific Northwest Lab., P.O. Box 999, Richland, WA (US)). pp 69-82 of Influence of radiation on material properties: ASTM 13th international symposium (Part II). Garner, F.A.; Henager, C.H.; Igata, N. Philadelphia, PA; ASTM (1987). (CONF-860605—).

From 13. international symposium on the effects of radiation on materials; Seattle, WA, USA (23 Jun 1986).

Light-ion irradiation creep testing was combined with microhardness testing to study changes in creep strength of two model ferritic alloys. Creep enhancement followed by radiation hardening was observed for both alloys. Post-irradiation creep rates and post-irradiation microhardness data confirm that significant radiation hardening occurred due to the 673 K deuteron bombardment of 0.05 displacements per atom (dpa). Measured rapid creep rates were consistent with a climb-glide creep model developed for pure Ni after dislocation bias factors were reduced by a factor of five to account for the body centered cubic (bcc) structure. This was attributed to the relative insensitivity of climb-glide creep to the interstitial bias, and to the fact that the small dislocation loops were unfaulted in the ferritic alloy but were initially faulted loops in the Ni. Electron microscopy revealed that a high density of small dislocation loops were formed during the irradiation. Microhardness testing results were consistent with irradiation hardening due to dislocation loops, as were the creep results.

46898 **In-reactor creep rupture behavior of the D19 and 316 alloys.** Puigh, R.J.; Hamilton, M.L. (Westinghouse Hanford Co., Richland, WA (US)). pp 22-29 of Influence of radiation on material properties: ASTM 13th international symposium (Part II). Garner, F.A.; Henager, C.H.; Igata, N. Philadelphia, PA; ASTM (1987). (CONF-860605—).

From 13. international symposium on the effects of radiation on materials; Seattle, WA, USA (23 Jun 1986).

In-reactor creep rupture data on one heat and two cold work levels of the D9-type alloy and on two heats of cold worked 316 stainless steel have been obtained from the Materials Open Test Assembly (MOTA) experiment in the Fast Flux Test Facility (FFTF). The on-line detection of creep ruptures using a tag gas technique has provided in-reactor creep rupture data for irradiation temperatures of 575, 605, 670, and 750°C to a peak fluence of 9 x 10/sup 22/ n/cm/sup 2/ (E > 0.1 MeV). Similar thermal creep rupture data have been accumulated for exposure temperatures of 650, 704, and 760°C to exposure times of 10 000h. In general, the in-reactor rupture times are comparable to or less than those exhibited by the thermal testing. The 10% cold worked condition of D9

exhibits slightly better creep rupture resistance when compared to the 20% cold worked condition. The in-reactor failure strains are less than those of the thermal controls for a given temperature.

46899 **Cessation of irradiation creep in AISI 316 concurrent with high levels of swelling.** Porter, D.L.; Garner, F.A. (Argonne National Lab., EBR-II Project, Idaho Falls, ID (US)). pp 11-21 of Influence of radiation on material properties: ASTM 13th international symposium (Part II). Garner, F.A.; Henager, C.H.; Igata, N. Philadelphia, PA; ASTM (1987). (CONF-860605—).

From 13. international symposium on the effects of radiation on materials; Seattle, WA, USA (23 Jun 1986).

At high neutron exposures where the swelling of AISI 316 exceeds —5% the irradiation creep rate at 550°C begins to decline and eventually disappear. Swelling continues to proceed, however, leading to a maximum deformation rate dictated only by that of the steady-state swelling rate or —0.33%/displacements per atom (dpa). It is not clear at this point whether large levels of voidage are directly responsible for the decrease in creep rate. There is some evidence to support the possible role of intermetallic precipitate formation, although the mechanism of creep suppression by such precipitates is not known.

46900 **Preparation of actinide-metal research materials.** Aaron, W.S.; Culpepper, C.A.; Campbell, K.B. (Oak Ridge National Lab., TN (USA)). *Transactions of the American Nuclear Society;* 52: 348(1986). (CONF-860610—Summs.).

From American Nuclear Society annual meeting; Reno, NV, USA (15 Jun 1986).

The preparation of actinide-metal research materials is one of many functions of the Isotope Research Materials Laboratory (IRML) at Oak Ridge National Laboratory. Research samples of uranium, plutonium, americium, and curium, typically from milligram quantities up to ~ 100 g, are prepared as pure metals or alloys to customer specifications. Larger quantities, up to many kilograms, of the lower activity actinides, such as ^{235}U, ^{238}U, and ^{232}Th, are also fabricated into custom research forms. Physical forms of these metals include rolled foils or sheets, castings (ingot, rod, or special shapes), and evaporated or sputtered films. The actinide-metal processing capabilities of the IRML are continuing to be improved and applied to a wide variety of custom material preparations to meet the needs of the world-wide research community.

46901 **Volume and grain boundary diffusion in L1/sub 2/ alloys with special reference to Ni/sub 3/Al compounds.** Chou, T.C.; Chou, Y.T. (Dept. of Metallurgy and Materials Engineering, Lehigh Univ., Bethlehem, PA (US)). pp 461-474 of High-temperature ordered intermetallic alloys. Koch, C.C.; Liu, C.T.; Stoloff, N.S. Pittsburgh, PA; Materials Research Society (1985). (CONF-8411308—).

From High-temperature ordered intermetallic alloys; Boston, MA, USA (26 Nov 1984).

Experiment and theory of diffusion in L1(2) alloys are briefly reviewed. Current work on volume and grain boundary diffusion in Ni(3)Al alloys are presented and discussed.

46902 **Weldability of Ni/sub 3/Al-type aluminide alloys.** Santella, M.L.; David, S.A.; White, C.L. (Metals and Ceramics Div., Oak Ridge National Lab., P.O. Box X, Oak Ridge, TN (US)). pp 495-504 of High-temperature ordered intermetallic alloys. Koch, C.C.; Liu, C.T.; Stoloff, N.S. Pittsburgh, PA; Materials Research Society (1985). (CONF-8411308—).

From High-temperature ordered intermetallic alloys; Boston, MA, USA (26 Nov 1984).

If the ductile Ni/sub 3/Al-based aluminides are to achieve their full potential as engineering materials, they must demonstrate a capability for being joined by conventional welding processes. The goal of this study was to identify some of the factors controlling weldability of the ductile aluminides. The alloys selected for this initial study were boron-doped Ni/sub 3/Al and Ni/sub 3/Al containing 10 at. 5 Fe. Sheet stock was used to make full penetration autogenous welds by the electron beam and gas tungsten arc processes. The main process variables were travel speed and preheat. The as welded coupons were examined visually and by normal metallographic methods. Although sounds welds were made, initial results indicated weldments of these alloys are susceptible to cracking. Weldability of the ductile Ni/sub 3/Al-based aluminides was found to be affected by alloy composition and welding speed.

46903 **Magnetic studies of Ni/sub 3/Al(Fe) compounds.** Sekula, S.T.; Kerchner, H.R.; Thompson, J.R.; Leventouri, T. (P.O. Box X, Oak Ridge National Lab., Oak Ridge, TN (US)). pp 513-520 of High-temperature ordered intermetallic alloys. Koch, C.C.; Liu, C.T. Pittsburgh, PA; Materials Research Society (1985). (CONF-8411308—).

From High-temperature ordered intermetallic alloys; Boston, MA, USA (26 Nov 1984).

Several samples of the ordered intermetallic compound with the L1/sub 2/ structure and chemical composition Ni/sub 0.75-x/ Al/sub 0.25-x/Fe/sub 2x/ (doped with 0.2 at. % B) have been studied over an Fe compositional range $0 \leqq 2x \leqq 0.20$. Stoichiometric Ni/sub 3/Al is known to be a strongly exchange-enhanced material, forming a giant moment system when Fe impurities are introduced in trace amounts. For the greater Fe concentrations employed in this work, more conventional ferromagnetic systems are obtained. Well below the ferromagnetic Curie temperature T/sub c/ the samples exhibit a spontaneous moment in small magnetic fields and at higher fields the isothermal magnetization data show a clear tendency toward saturation. Magnetic investigations using vibrating-sample techniques permitted measurements over the temperature interval from 4.2 K to 800 K in fields up to 5.0 T. The Curie temperature was found to increase from —50 K for the Fe-free sample in the series to 410 K for the limiting concentration of 12 at. % Fe in the L1/sub 2/ structure. Samples with higher Fe content up to 20 at. % contain a second, disordered fcc phase with T/sub c/ $\simeq$ 715 K. Peaks in the temperature dependence of the lattice parameter observed in x-ray studies yield T/sub c/ values in reasonable agreement with the magnetic measurements.

46904 **Physical properties of Ni/sub 3/Al containing 24 and 25 atomic percent aluminum.** Williams, R.K.; Graves, R.S.; Weaver, F.J.; McElroy, D.L. (Metals and Ceramics Div., Oak Ridge National Lab., Oak Ridge, TN (US)). pp 505-512 of High-temperature ordered intermetallic alloys. Koch, C.C.; Liu, C.T.; Stoloff, N.S. Pittsburgh, PA; Materials Research Society (1985). (CONF-8411308—).

From High-temperature ordered intermetallic alloys; Boston, MA, USA (26 Nov 1984).

Thermal conductivity, electrical resistivity, Seebeck coefficient and thermal expansion data were obtained on well-annealed Ni/sub 3/Al containing 24 and 25 at. % Al. The results span the temperature range 300 to 1000 K. The expansion coefficients did not vary with composition and increased with temperature, reaching values of about 17 x 10/sup -6/ K/sup -1/ at 1000 K. The thermal conductivity and electrical resistivity changed rapidly with composition, and the thermal conductivity of 24 at. % Al is as much as 30% lower than that for stoichiometric Ni/sub 3/Al. The electronic Lorenz function of Ni/sub 3/Al was obtained by subtracting the estimated phonon conductivity component and found to be within about 5% of the Sommerfeld prediction from 300 to 1000 K. The electrical resistivity results for stoichiometric Ni/sub 3/Al are influenced by the loss of ferromagnetic order at lower temperatures and are not adequately described by the Bloch-Grueisen equation.

46905 **The oxidation of nickel-aluminum and iron-aluminum alloys.** Cathcart, J.V. (Metals and Ceramics Div., Oak Ridge National Lab., P.O. Box X, Oak Ridge, TN (US)). pp 445-460 of High-temperature ordered intermetallic alloys. Koch, C.C.; Liu, C.T.; Stoloff, N.S. Pittsburgh, PA; Materials Research Society (1985). (CONF-8411308—).

From High-temperature ordered intermetallic alloys; Boston, MA, USA (26 Nov 1984).

The high-temperature oxidation behavior of several ordered alloys in the Ni-Al and Fe-Al systems is reviewed with special emphasis on Ni/sub 3/Al and NiAl. Ordering influences oxidation through its effect on the activities of the alloy components and by changing the point defect concentration in an alloy. Three categories of Ni-Al alloys are distinguished based on Al content and oxidation behavior. A characteristic feature of the oxidation of high-

aluminum Ni-Al and Fe-Al alloys is the formation of voids in the substrate at the oxide-metal interface. The mechanism of void formation and its suppression by minor additions of oxygen-active elements is discussed. A brief description of the effect of preoxidation on the reactions of Ni/sub 3/Al-base alloys in SO/sub 2//O/sub 2/ environments is also included.

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REFER ALSO TO CITATION(S) 46761, 46879, 46965, 46993, 47083, 47200, 47876, 47878

46906 (BNL—41427) Microstructural defects and superconducting critical currents in superconductors. Suenaga, M. (Brookhaven National Lab., Upton, NY (USA)). 1988. Contract AC02-76CH00016. 13p. (CONF-880529—2). NTIS, PC A03/MF A01; 1; GPO Dep. Order Number DE88013781/JAW.

From MRS international meeting on advanced materials; Tokyo, Japan (30 May 1988).

Superconducting critical current density is an extrinsic property of a superconductor and depends primarily on the interaction of crystal-structural defects and magnetic flux lines. The most effective characteristic defect size for the interaction is generally thought to be of an order of the superconducting coherence length. In order to understand critical current densities in the high temperature superconductors, the coherence lengths for some of metallic and oxide superconductors are listed and these are compared with the microstructural defects as observed by transmission electron microscopy. 42 refs., 7 figs.

46907 (BNL—41439) Soft modes in condensed matter physics. Shirane, G. (Brookhaven National Lab., Upton, NY (USA)). 1988. Contract AC02-76CH00016. 20p. (CONF-880529—3). NTIS, PC A03/MF A01; 1; GPO Dep. Order Number DE88013989/JAW.

From MRS international meeting on advanced materials; Tokyo, Japan (30 May 1988).

The soft mode concept has played an important and successful role in the understanding of a variety of phase transitions in condensed matter. We demonstrate this in the latest example of the high T/sub c/ superconductor of La_2CuO_4 and related compounds. Then we discuss, in some detail, recent neutron scattering studies of soft modes in the Martensitic alloy Ni-Al. 13 refs., 7 figs.

46908 (BNL—41441) Spin correlations in high T/sub c/ superconductors. Shirane, G. (Brookhaven National Lab., Upton, NY (USA)). 1988. Contract AC02-76CH00016. 17p. (CONF-880705—3). NTIS, PC A03/MF A01; 1; GPO Dep. Order Number DE88013988/JAW.

From International conference on magnetism; Paris, France (25 Jul 1988).

A review is given of current neutron scattering experiments on La/sub 2{minus}x/Sr/sub x/CuO_4 and YBa_2Cu_3O/sub 6+x/. Large single crystals have now been successfully grown for both of these high T/sub c/ superconductors and extensive measurements are being carried out on magnetic excitations for wide ranges of temperature and composition. A novel type of two-dimensional spin correlation is found with unusually large J/sub 2D/{congruent} 1000K. 18 refs., 10 figs.

46909 (BNL—41458) The efficiencies and error-rates of Euclidean and Mahalanobis searches in hypergeometries of archaeological ceramic compositions. Harbottle, G. (Brookhaven National Lab., Upton, NY (USA)). Jun 1988. Contract AC02-76CH00016. 57p. NTIS, PC A04/MF A01; 1; GPO Dep. Order Number DE88013995/JAW.

The data presented permit a number of conclusions to be drawn: 1) In several well-characterized, tightly-knit groups, the use of 17 elements results, in Euclidean space, in essentially unique fingerprints. The error-rates are no more than one or two per ten thousand. Even when the elements are reduced to 10, there is still in these cases excellent characterization. When only 6 elements are employed, uniqueness is seriously compromised. Results based on less than elements are essentially meaningless. 2) In several other cases, there is a small error rate, typically 1-4%, in a Euclidean search utilizing even 17 elements. Short Euclidean distances cannot prove archaeological affiliation but, when combined with concordance of stylistic criteria, similarity in paste petrography, etc., may now give strong additional evidence as to long-distance contacts. It was suggested that the widespread occurrence of bivariate correlation in natural clays and archaeological ceramics could considerably sharpen the uniqueness of the "fingerprint" characterization of archaeological groups if one first transformed the space in such a way as to remove the correlations from the focal group. Those of us who have been involved in the characterization of archaeological ceramics through their analytical compositional signatures have had the intuitive feeling that the method worked fairly well; that one could distinguish sherds that lay in or out of particular clusters with some assurance, provided one employed a sufficient number of elements. The present paper demonstrates just how good that characterization can become, and roughly how many elements need be considered, to achieve a reliable result. 27 refs., 13 figs., 3 tabs.

46910 (CEGB-TPRD/B—0964/R87) X-ray photoelectron spectroscopy of the uranium/oxygen system. Part II. Surface morphology and characterisation of crystalline UO/sub 2/ oxidised in 1 Torr of oxygen at 25/sup 0/C, 225/sup 0/C and 300/sup 0/C. Allen, G.C.; Tempest, P.A.; Tyler, J.W. (Central Electricity Generating Board, Berkeley (UK). Berkeley Nuclear Labs.). Aug 1987. 50p. NTIS (US Sales Only), PC A03/MF A01. Order Number DE88754270/JAW.

As part of a wider program to investigate the low temperature oxidation behaviour of Commercial Advanced Gas-cooled Reactor UO/sub 2/ fuel pellets in the event of gas ingress to a fuel can during handling or storage, the behaviour of individual grains in bulk UO/sub 2/ has been simulated using single crystal surfaces. To this end the oxidation of (111), (110) and (100) planar slices of crystalline UO/sub 2/ together with a polycrystalline sample of current fuel product have been oxidised in 1 Torr of oxygen at 25/sup 0/C, 225/sup 0/C and 300/sup 0/C. The oxidation process was monitored using X-ray photoelectron spectroscopy, X-ray diffraction and scanning electron microscopy to cross-correlate changes in surface chemistry, bulk composition and oxide morphology. Factors governing the oxidation behaviour of different crystalline UO/sub 2/ slices are discussed and it is proposed that the observed reactivity reflects the ease with which oxygen interstitial atoms are incorporated into the new oxide forming at the U/sub 3/O/sub 7// UO/sub 2/ interface.

46911 (CONF-8805152—1) Characterization of ceramic films and interfaces by electron microscopic and spectroscopic techniques. Erdemir, A.; Cheng, C.C. (Argonne National Lab., IL (USA)). 1988. Contract W-31109-ENG-38. 31p. NTIS, PC A03. Order Number DE88011957/JAW.

From Electron microscopy of surfaces and interfaces; Oak Brook, IL, USA (16 May 1988).

In this study, Auger electron spectroscopy (AES) in combination with inert gas ion milling and cross-sectional transmission electron microscopy (XTEM) were employed to investigate the chemical and microstructural characteristics of a TiN film on a M50 steel and the film-substrate interfaces formed during ion plating at 100 C and 500 C deposition temperatures. The results of both analytical techniques indicated that the coating produced at 100 C was composed of a thin Ti layer (approximately 1000 A) and a thick TiN layer. Upon vacuum annealing at 500 C for 45 minutes, it was found that the Ti rich interlayer was transformed into a TiC phase. The coating produced at 500 C consisted of a thin TiC and a relatively thick TiN layers. Ion plating as well as post vacuum annealing at 500 C resulted in grain growth and reduced defect density. 11 refs., 8 figs.

46912 (DOE/ER/01198—T13) Examination of the CaO–Dy_2O_3 system for potential use as a transformation toughening system. Fleming, M.M. (Illinois Univ., Urbana (USA)). 1988. Contract AC02-76ER01198. 114p. NTIS, PC A06/MF A01; 1; GPO Dep. Order Number DE88014174/JAW.

Similarities exist between the polymorphic transformations of ZrO_2 and those of Dy_2O_3, indicating the possibility of the latter for development as a transformation toughener. The monoclinic (B) to cubic (C) inversion on cooling of Dy_2O_3 is of particular interest, as it is accompanied by an 8% volume expansion on cooling, and

occurs quickly enough to cause scattering of bulk specimens. The temperature of the B → C transformation appears to vary between specimens prepared with different starting powders, inhibiting precise definition of T/sub tr/. Solid solution formation with CaO enables retention of the B-phase at room temperature, provided the cooling is carried out at a sufficiently rapid rate. This monoclinic phase exhibits a modulated microstructure, as observed by TEM, characteristic of metastability, or possibly, incipient spinodal decomposition. Phase separation (B + C) within a single grain was not observed. A high rate of eutectoidal decomposition into CaO and C-Dy_2O_3 was also observed, believed to be a factor contributing to the strong cooling rate dependence of the amount of B-phase retained at room temperature. 77 refs., 29 figs.

46913 **(DOE/ER/45228—37) Surface structures and reactions of ceramics and metals: Progress report, December 1, 1985-November 30, 1988.** Cowley, J.M. (Arizona State Univ., Tempe (USA). Dept. of Physics). Jun 1988. Contract FG02-86ER45228. 22p. NTIS, PC A03/MF A01; 1; GPO Dep. Order Number DE88013752/JAW.

Several novel techniques using electron microscopy instruments, as well as standard techniques, have been applied to the study of the surfaces of ceramic oxides and the interaction of thin films and small particles of metals with the oxide surfaces. Reactions of thin metal films with cleavage surfaces of MgO have shown a strong dependence on the preparation of the surface, the temperature of deposition and the amount of electron irradiation by the incident beam. Small metal particles of oxide supports such as occur in supported catalyst systems, have been shown by use of microdiffraction to be epitaxed on the crystallites of the oxide support. Some show unusual crystalline forms, as in the case of the faulted body-centered-cubic crystals of Ru in Ru-Au bimetallic catalysts, or else a variety of states of oxidation. Electronic excitations of supported metal particles are strongly influenced by the form and composition of the support. In reflection diffraction and electron energy loss analysis from extended crystal surfaces, particular diffraction conditions give rise to surface channelling phenomena so that the observations are dependent on the structure and composition of the surface layers of atoms, providing the basis for new surface analysis techniques which may be correlated with high resolution. 27 refs.

46914 **(INIS-BR—1164, pp 106) Evaluation of the thickness of Nb/sub 2/O/sub 5/ and Ta/sub 2/O/sub 5/ semiconductor thin films by differential capacitance.** Juliao, J.F.; Gomes, U.U.; Pinatti, D.G. (Ceara Univ., Fortaleza (Brazil). Dept. de Fisica; Rio Grande do Norte Univ., Natal (Brazil); Universidade Estadual de Campinas (Brazil)). 1987. (In Portuguese). NTIS (US Sales Only), PC A09/MF A01. Order Number DE88703566/JAW. (CONF-8705181—).

From 10. national meeting on condensed matter physics; Caxambu, Brazil (5 May 1987).

46915 **(INIS-BR—1164, pp 45) Viscosity study during the silica sol-gel transformation.** Kinouchi Filho, O.; Aegerter, M.A. (Sao Paulo Univ., Sao Carlos, SP (Brazil). Inst. de Fisica e Quimica). 1987. (In Portuguese). NTIS (US Sales Only), PC A09/MF A01. Order Number DE88703566/JAW. (CONF-8705181—).

From 10. national meeting on condensed matter physics; Caxambu, Brazil (5 May 1987).

46916 **(INIS-BR—1164, pp 45) Dielectric response of silica aerogels.** Silva, A.A. da; Aegerter, M.A. (Sao Paulo Univ., Sao Carlos, SP (Brazil). Inst. de Fisica e Quimica). 1987. (In Portuguese). NTIS (US Sales Only), PC A09/MF A01. Order Number DE88703566/JAW. (CONF-8705181—).

From 10. national meeting on condensed matter physics; Caxambu, Brazil (5 May 1987).

46917 **(INIS-BR—1164, pp 102) Piezoelectric ceramics of lead zirconate titanate (PZT): preparation and characterization.** Menegazzo, B.A.; Garcia, D.; Gelfuso, M.V.; Eiras, J.A.; Jordao, J.A.R. (Sao Carlos Univ. (Brazil). Dept. de Fisica). 1987. (In Portuguese). NTIS (US Sales Only), PC A09/MF A01. Order Number DE88703566/JAW. (CONF-8705181—).

From 10. national meeting on condensed matter physics; Caxambu, Brazil (5 May 1987).

46918 **(INIS-BR—1164, pp 101) Phase transformations in ceramics submitted to high pressures.** Pereira, A.S.; Jornada, J.A.H. da. (Rio Grande do Sul Univ., Porto Alegre (Brazil). Inst. de Fisica). 1987. (In Portuguese). NTIS (US Sales Only), PC A09/MF A01. Order Number DE88703566/JAW. (CONF-8705181—).

From 10. national meeting on condensed matter physics; Caxambu, Brazil (5 May 1987).

46919 **(INIS-BR—1164, pp 102) Study of dielectric properties in the exchange solid solution (Ba/sub 1-x/ Sr/sub x/ (TiO/sub 3/)).** Muniz, L.R.; Pontuschka, W.M. (Sao Paulo Univ. (Brazil). Inst. de Fisica). 1987. (In Portuguese). NTIS (US Sales Only), PC A09/MF A01. Order Number DE88703566/JAW. (CONF-8705181—).

From 10. national meeting on condensed matter physics; Caxambu, Brazil (5 May 1987).

46920 **(IYF-R—9-282) Gamma irradiation effect on low temperature electric conductivity of ceramic dielectric materials and glasses.** Muminov, M.I.; Mukhamedzhanov, M.A. (AN Uzbekskoj SSR, Tashkent. Inst. Yadernoj Fiziki). 1987. 8p. (In Russian). NTIS (US Sales Only), PC A02/MF A01. Order Number DE88703645/JAW.

Influence of gamma irradiation of electric conductivity of ceramic insulators and glasses in 80-300 K temperature range is investigated. It is demonstrated that the increase of crystal phase content in ceramics promotes the growth of radiation electric conductivity. It is supposed, that radiation electric conductivity of ceramics is stipulated by the hopping mechanism of charge transfer. 7 refs.; 1 fig.

46921 **(N—88-22194) Test for interfacial effects and stress transfer in ceramic matrix composites. Progress report, 1 September 1987-1 April 1988.** (Utah Univ., Salt Lake City (USA)). May 1988. 25p. (NASA-CR—182758; NAS—1.26:182758). NTIS, PC A03/MF A01.

A test specimen was devised for measuring stress transfer between a high modulus fiber and a ceramic matrix. Single filaments of SiC were embedded in chemically vapor deposited SiC on a thin plate of molybdenum. The CVD overcoating which encapsulated the fiber was continuous with a coating of SiC on the molybdenum. When placed in a microtensile test device and loaded in the fiber direction, the fiber fracture characteristics provide information on the fiber/matrix adhesion and stress transfer. Problems were encountered due to the formation of a weak boundary between the SiC and the molybdenum which obviated any meaningful tensile tests. Also, the high CVD temperature used in fabricating these specimens restrict the fiber, matrix (and substrate) to materials having similar thermal coefficients of expansion in order to minimize thermal stresses.

46922 **(N—88-22197) Hafnia-rich mixed oxide ceramics of the system HfO_2-ZrO_2-TiO_2 for heaters and heat exchangers in electrothermal thrusters: The effects of titania on selected electrical and mechanical properties of hafnia-rich mixed oxides in the system hafnia-zirconia-titania, volume 1.** Staszak, P.R.; Wirtz, G.P.; Berg, M.; Brown, S.D. (Illinois Univ., Urbana (USA)). May 1988. 146p. (NASA-CR—182800-VOL-1; NAS—1.26:182800-VOL-1). NTIS, PC A07/MF A01.

A study of the effects of titania on selected properties of hafnia-rich mixed oxides in the system hafnia-zirconia-titania (HZT) was made in the region 5 to 20 mol percent titania. The studied properties included electrical conductivity, thermal expansion, and

fracture strength and toughness. The effects of titania on the properties were studied for the reduced state as well as the oxidized state of the sintered mixed oxides. X-ray analysis showed that the materials were not always single phase. The oxidized compositions went from being monoclinic solid solutions at low titania additions to having three phases (two monoclinic and a titanate phase) at high additions of titania. The reduced compositions showed an increasing cubic phase presence mixed with the monoclinic phase as titania was added. The electrical conductivity increased with temperature at approximately 0.1 mhos/cm at 1700 C for all compositions. The thermal expansion coefficient decreased with increasing titania as did the monoclinic to tetragonal transformation temperature. The fracture strength of the oxidized bars tended to decrease with the addition of titania owing to the presence of the second phase titania. The fracture strength of the reduced bars exhibited a minimum corresponding to a two-phase region of monoclinic and cubic phases. When the second phases were suppressed, the titania tended to increase the fracture strength slightly in both the oxidized and reduced states. The fracture toughness followed similar trends.

46923 (N—88-22408, pp vp) **Characterization of sintered SiC by using NDE.** Baaklini, G.Y. May 1988. NTIS, PC A16/MF A01. (NASA-CP—3003-VOL-3; E—3970-VOL-3; NAS—1.55:3003-VOL-3; CONF-8805178—).

From Lewis structures technology symposium; Cleveland, OH, USA (24 May 1988).

Capabilities of projection microfocus X-radiography and of ultrasonic velocity and attenuation for characterizing silicon carbide specimens were assessed. Silicon carbide batches covered a range of densities and different microstructural characteristics. Room-temperature, four-point flexural strength tests were conducted. Fractography was used to identify types, sizes, and locations of fracture origins. Fracture toughness values were calculated from fracture strength and flaw characterization data. Detection capabilities of radiography for fracture-causing flaws were evaluated. Applicability of ultrasonics for verifying material strength and toughness was examined. Radiography proved useful in detecting high-density inclusions and isolated voids, but failed in detecting surface and subsurface agglomerates and large grains as fracture origins. Ultrasonic velocity dependency on density was evident. Attenuation dependency on density and mean pore size was clearly demonstrated. Understanding attenuation as a function of toughness was limited by shortcomings in K sub IC determination.

46924 (N—88-22408, pp vp) **Flaw characterization in structural ceramics using scanning laser acoustic microscopy.** Roth, D.J. May 1988. NTIS, PC A16/MF A01. (NASA-CP—3003-VOL-3; E—3970-VOL-3; NAS—1.55:3003-VOL-3; CONF-8805178—).

From Lewis structures technology symposium; Cleveland, OH, USA (24 May 1988).

The ability of scanning laser acoustic microscopy (SLAM) to characterize artifically seeded voids in sintered silicon nitride structural ceramic specimens was investigated. The voids ranged from 20 to 430 microns in diameter and were embedded up to 2 mm beneath the surface of the specimens. Probability of detection was determined as a function of void depth and size. Trigonometric relationships and Airy's diffraction theory were used to obtain predictions of void depth and size from acoustic diffraction patterns produced by the voids. Agreement was observed between actual and predicted void depths. However, predicted void diameters were generally much greater than actual diameters. Precise diameter predictions are difficult to obtain because of measurement uncertainty and the limitations of the 100 MHz SLAM applied to typical ceramic specimens.

46925 (N—88-22408, pp vp) **Nondestructive evaluation of sintered ceramics.** Baaklini, G.Y.; Klima, S.J.; Sanders, W.A. May 1988. NTIS, PC A16/MF A01. (NASA-CP—3003-VOL-3; E—3970-VOL-3; NAS—1.55:3003-VOL-3; CONF-8805178—).

From Lewis structures technology symposium; Cleveland, OH, USA (24 May 1988).

Radiography and several acoustic and thermoacoustic microscopy techniques are investigated for application to structural ceramics for advanced heat engines. A comparison is made of the results obtained from the use of scanning acoustic microscopy (SAM), scanning laser acoustic microscopy (SLAM), and thermoacoustic microscopy (TAM). These techniques are evaluated on research samples of green and sintered monolithic silicon nitrides and silicon carbides in the form of modulus-of-rupture (MOR) bars containing deliberately introduced flaws. Strengths and limitations of the techniques are described, with the emphasis being on statistics of detectability of flaws that constitute potential fracture origins. Further, it is shown that radiographic evaluation and guidance helped develop uniform high-density Si_3N_4 MOR bars with improved four-point flexural strength (875, 544, and 462 MPa at room temperature, 1200 C, 1370 C, respectively) and reduced scatter in bend strength.

46926 (NP—8770272) **Development, high temperature properties and microanalysis of non-oxide ceramics. Final report.** Grathwohl, G. (Karlsruhe Univ. (T.H.) (Germany, F.R.). Inst. fuer Werkstoffkunde 2; Bundesministerium fuer Forschung und Technologie, Bonn (Germany, F.R.)). May 1987. 151p. (In German). NTIS (US Sales Only), PC A08/MF A01. Order Number DE88770272/JAW.

RBSN-materials with additives (3.0-5.2% Y/sub 2/O/sub 3/) and (0.5-2.6% Al/sub 2/O/sub 3/) were postsintered, after optimization of the sintering process densities between 94 and 97% TD were reached. A three-step sintering process was found as optimum by kinetic studies. The microstructures of the postsintered materials can be improved by using RBSN starting materials with smaller and uniformly distributed pores. Thus, density and properties can be further improved. Advanced testing methods were developed: Tensile creep test in theoretical considerations, reverse cyclic bending in preliminary tests and new crack growth measurements were applied for first test series. Crack growth measurements were performed on various ceramics under static and cyclic loading. Creep, oxidation and high temperature failure was studied for various Si/sub 3/N/sub 4/- and SIC-materials. The temperature dependence of the typically transient creep curves was determined and interpreted. Critical temperature ranges were identified which occur similar in creep as in oxidation. The different failure criteria for the various Si/sub 3/N/sub 4/- and SiC-materials and the temperature limits for application were evaluated. By microanalytical methods the state and distribution of sintering additives and impurities in SiC-materials were evaluated; further, the state of the grain boundaries of two HIPSiC-materials was described. Microstructural changes due to the oxidation of Si/sub 3/N/sub 4/-materials were analysed. (orig.) With 70 refs., 13 tabs., 67 figs.

46927 (ORNL/TM—10794) **Exploration of aluminum passivity by aqueous additives 25--40{degree}C: Potential application to ORNL Advanced Neutron Source (ANS).** Marshall, W.L. (Oak Ridge National Lab., TN (USA)). Jul 1988. Contract AC05-84OR21400. 23p. NTIS, PC A03/MF A01; 1; GPO Dep. Order Number DE88013189/JAW.

In anticipation of an ORNL Advanced Neutron Source (ANS) and possible limitations on neutron flux because of aluminum oxide buildup on heat exchanger surfaces, an exploration was made of aqueous additives for inhibiting corrosion. This study has confirmed previous, extensive studies during 1955-1965 showing that aluminum corrosion is a function of acidity, temperature, nature and concentration of electrolyte additive, and other variables. The exploration confirms that phosphate ion (of the electrolyte ions explored) appears to be good corrosion inhibitor for aluminum in acidic media, depending upon acidity and concentration at a given temperature. Nitrate ion at 25-200{degree}C in acidic media does not inhibit as well, but at temperatures of 200-400{degree}C seems to be relatively good. As the temperature rises, the pH (25{degree}C) must be lowered for best inhibition. Surprisingly, an alkaline, one molar ammonium bicarbonate solution appears to provide good corrosion resistance at temperatures up to 180{degree}C, appearing to be the best corrosion-protection additive (to 180{degree}C) of those explored. 9 refs., 4 tabs.

46929 (RISO-M—2694) Practical application of stepwise isothermal dilatometry for characterization of sinterability of powder compacts. El Sayed Ali, M.; Toft Soerensen, O. (Risoe National Lab., Roskilde (Denmark)). Feb 1988. 20p. NTIS (US Sales Only), PC A03/MF A01. Order Number DE88754086/JAW.

Stepwise isothermal dilatometry (SID) is a useful technique for sintering studies. With this technique isothermal shrinkage is characteristically determined as function of temperature without imposing conditions such as heating rate or temperature on the specimen. Sintering is thus performed under equilibrium conditions and the information obtained is directly related to the properties of the specimens. In the present work the temperature for maximum densification rate was determined for various yttria partially stabilized zirconia powders (YPSZ). Plotting this temperature versus the crystallite size of the starting powders showed a linear relationship indicating that this technique can be used to characterize the sinterability of these powders. As the maximum densification rate for most ceramic powders are believed to be the temperature at which grain growth is initiated, this technique can also be used to predict conditions for production of fine grained ceramics. 10 refs.

46929 (SAND—88-0299C) What is the origin of "glassy" behavior in the high-T/sub c/ oxides?. Kwak, J.F.; Venturini, E.L. (Sandia National Labs., Albuquerque, NM (USA)). 1988. Contract AC04-76DP00789. 6p. (CONF-880669—3). NTIS, PC A02/MF A01; 1; GPO Dep. Order Number DE88012668/JAW.

From International conference on science and technology of synthetic metals; Santa Fe, NM, USA (26 Jun 1988).

The anomalous low-field magnetic properties of the high-T/sub c/ oxide crystals have been interpreted alternatively in terms of a superconductive glass state or, more recently, giant flux creep. The glass picture as proposed assumes the occurrence of intragranular Josephson junctions on a length scale small compared to the penetration depth, and has been used to explain the properties of both single-crystal and ceramic samples. The flux creep picture deals only with pinning forces and ignores weak links, and thus far has been applied only to single crystals. We show here that neither of these models adequately describes the behavior of ceramic materials. A physically accurate picture of such materials must take into account intergranular Josephson junctions and resultant grain decoupling at low magnetic fields. 15 refs., 2 figs.

46930 (SAND—88-0956C) Microscopy and microanalysis of shock-processed materials. Carr, M.J.; Graham, R.A. (Sandia National Labs., Albuquerque, NM (USA)). 1988. Contract AC04-76DP00789. 14p. (CONF-880841—7). NTIS, PC A03. Order Number DE88008471/JAW.

From MAS/EMSA microbeam analysis conference; Milwaukee, WI, USA (7 Aug 1988).

The passage of a shock compressive pulse through a material consists of a brief excursion to high pressure and temperature, concurrent with high strain rate deformation, followed promptly by a return to nominal conditions. The short duration of the shock pulse and the rapid quench combine to produce complex chemical and microstructural changes on a very fine scale. The analytical electron microscope and electron microprobe have been successfully employed to analyze a variety of materials systems exposed to shock loading. Case studies of rutile, Al-Ni reacting powder mixtures, and zinc oxide-hematite reactions are used to illustrate the applicability of these methods to the characterization and analysis of shock processed materials. 17 refs., 8 figs.

46931 (Y/DV—724) The effect of carbon and boron nitride additions on the fracture toughness of Si_3N_4. Gorin, A.H. (Oak Ridge Y-12 Plant, TN (USA)). May 1988. Contract AC05-84OS21400. 17p. NTIS, PC A03/MF A01; 1; GPO Dep. Order Number DE88013249/JAW.

Silicon nitride has long been an attractive high-temperature material, and its consideration for implementation in engine construction has placed a premium on the development of improved mechanical properties. The experiments performed here have a dual objective: (1) to observe the effect of low-level carbon (<2 percent) and boron nitride (<10 percent) additions on the fracture toughness of silicon nitride, and (2) to provide a foundation for possible microwave study of the material. All specimens were prepared by hot-pressing the heat-treated powders, using graphite dies and rams with conditions of {approximately}1800{degree}C, {approximately}30-50 min., and pressure of {approximately}2500 psi ({approximately}17.2 MPa). Boron nitride, or "grafoil", was used as a die release agent. Sections of each specimen were analyzed by x-ray diffraction, examined by scanning electron microscopy (SEM), evaluated for density, and mounted and polished for further study. To determine the toughness and hardness of each mounted-and-polished sample, a method incorporating the Vickers' indent size to crack length relationship provided by Oak Ridge National Laboratory was utilized. Results are presented and discussed. 10 figs., 1 tab.

46932 High-resolution electron microscopy of the c = 30.5 A and c = 38.2 A polytypoids in the Bi-Ca-Sr-Cu-O superconductor. Hetherington, C.J.D.; Ramesh, R.; O'Keefe, M.A.; Kilaas, R.; Thomas, G.; Green, S.M.; Luo, H.L. (National Center for Electron Microscopy, Lawrence Berkeley Laboratory, Department of Materials Science and Mineral Engineering, University of California, Berkeley, California 94720). *Applied Physics Letters;* **53**: No. 11, 1016-1018(12 Sep 1988).

We report results of high-resolution structure imaging, image processing, and simulation of the c = 30.5 A (T/sub c/ = 80 K) and c = 38.2 A (T/sub c/ = 115 K) superconducting polytypoids in the Bi-Ca-Sr-Cu-O system. The increase in c parameter is due to the insertion of two layers of Cu-O perovskite+Ca atoms in each unit cell. From the processed image and simulations, it appears that the central Cu layer in the c = 38.2 A polytypoid may be oxygen deficient. In addition, the image simulation experiments suggest that the oxygen atoms in the Bi-O layers are located at the face center of the Bi lattice.

46933 Reactivity and passivation for Bi adatoms on YBa_2Cu_3O/sub 6.9/ and Bi_2Ca_1/sub +//sub x/Sr_2/sub -// sub x/Cu_2O_3/sub +//sub y/. Meyer H.M. III; Hill, D.M.; Weaver, J.H.; Nelson, D.L.; Goretta, K.C. (Department of Chemical Engineering and Materials Science, University of Minnesota, Minneapolis, Minnesota 55455). *Applied Physics Letters;* **53**: No. 11, 1004-1006(12 Sep 1988).

X-ray photoemission spectroscopy was used to examine the reactivity of clean YBa_2Cu_3O/sub 6.9/ and Bi_2Ca/sub 1+//sub x/Sr/sub 2-//sub x/Cu_2O/sub 8+//sub y/ surfaces with adatoms of vapor-deposited bismuth. For YBa_2Cu_3O/sub 6.9/, depositions ≦8 A of Bi induce O 1s, Cu 2p/sub 3/2/, and Bi 4f line-shape changes due to BiO bonding, limited oxygen loss from the substrate, partial conversion of Cu^{2+} to Cu^{1+}, and growth of Bi metal. For coverages greater than 8 A, there is no reaction and only Bi metal growth is observed. For Bi deposition onto Bi_2Ca/sub 1+//sub x/Sr/sub 2-//sub x/Cu_2O/sub 8+//sub y/, there is minimal reaction with only subtle O 1s and Cu $2p_3$/sub //$_2$ line-shape changes and the nucleation and growth of Bi metal starting at low coverages (≧2 A). Comparison shows that Bi is less reactive than other metals, except Ag and Au, and that Bi_2Ca/sub 1+//sub x/Sr/sub 2-//sub x/Cu_2O/sub 8+//sub y/ is more stable toward Bi deposition than YBa_2Cu_3O/sub 6.9/.

46934 Laser-pulse vaporization of uranium dioxide and other refractory materials. Olander, D.R.; Yagnik, S.K.; Tsai, C.H. (Department of Nuclear Engineering, University of California and Materials and Chemical Sciences Division, Lawrence Berkeley Laboratory, Berkeley, California 94720). *Journal of Applied Physics;* **64**: No. 5, 2680-2695(1 Sep 1988).

The nature of the vapor produced by pulse surface heating of UO_2 and several other materials was investigated using normal-mode laser pulses with peak power densities between 10^4 and 10^6 W/cm^2. Maximum surface temperatures measured by optical pyrometry ranged from 1900 to 4200 K. At temperatures below ~2400 K for UO_2, the vapor pulse followed the Hertz—Langmiur vacuum vaporization theory. More energetic transients produced gasdynamic blowoffs accompanied by significant supersaturation in the expanding plume. Neutron activation analysis of the collected vapor indicated that the total quantity of liquid UO_2 evaporated in the

pulse followed the Hertz—Langmuir formula. However, mass spectrometric analysis of the emitted vapor showed large deviations in the quantity and waveform shape of the monomer species. These and other features of the blowoff were satisfactorily explained in terms of nucleation and growth of polymeric species. Although UO_2 clusters were undetectable by the mass spectrometer, polymers of MgO and ZrO_2 were observed.

46935 Superconducting coatings in the system Bi-Ca-Sr-Cu-O prepared by plasma spraying. Asthana, A.; Han, P.D.; Falter, L.M.; Payne, D.A.; Hilton, G.C.; Van Harlingen, D.J. (Department of Materials Science and Engineering and Materials Research Laboratory, University of Illinois at Urbana—Champaign, Illinois 61801). *Applied Physics Letters;* 53: No. 9, 799-801(29 Aug 1988).

Superconducting coatings in the system Bi-Ca-Sr-Cu-O were deposited on alumina substrates by plasma spray methods. The coatings were superconducting in the "as-sprayed" condition and improved with heat treatment. The best results were for coatings with resistivity values near 10 mΩ cm at room temperature and zero resistance at 96 K. The coatings had a magnetic transition near 80 K, with a weak diamagnetic signal up to 112 K. Superconductivity in the coatings was associated with two distinct phases, one of which was not identified. Scanning electron microscopy, x-ray diffraction, electrical resistivity, and magnetic measurements were used to characterize the coatings.

46936 Anomalous suppression of transport critical current below B/sub c/$_2$ (T) in oriented sintered samples of $DyBa_2Cu_3O_7$. Hampshire, D.P.; Seuntjens, J.; Cooley, L.D.; Larbalestier, D.C. (Applied Superconductivity Center, University of Wisconsin, 1500 Johnson Drive, Madison, Wisconsin 53706). *Applied Physics Letters;* 53: No. 9, 814-815(29 Aug 1988).

Measurements of the transport critical current density (J/sub c//sub t/) of textured sintered samples of $DyBa_2$ Cu_3 O_7 have been made as a function of temperature in magnetic fields up to 27 T. Data with the current orthogonal to the applied field for the high B/sub c/$_2$ (T) (Bperpendicularc axis) and the low B/sub c/$_2$ (T) (Bparallelc axis) orientations are presented. We report the anomalous suppression of the transport critical current when current flows along the c axis at 24 T and 4.2 K, a field which is well below B/sub c/$_2$ (~100 T)= at this temperature.

46937 Amorphous-to-crystalline transformations in bismuth-oxide-based high T/sub c/ superconductors. Garzon, F.H.; Beery, J.G.; Raistrick, I.D. (Los Alamos National Laboratory, Los Alamos, New Mexico 87545). *Applied Physics Letters;* 53: No. 9, 805-807(29 Aug 1988).

The transformation of high-resistivity amorphous Bi/sub 1.5/ $SrCaCu_2$ O/sub x/ to superconductive material has been characterized by structural, thermochemical, transport, and magnetic measurements. X-ray powder diffraction confirmed that rapid solidification of Bi-Sr-Ca-Cu-O melts yields amorphous materials. Differential scanning calorimetry indicated an exothermic crystallization peak at ~455 °C with a corresponding enthalpy of ~50 J/g. Thermal cycling of the insulating glass to a temperature above that required for crystallization results in a transformation from an insulating to a partially superconducting material with an onset temperature of 85 K.

46938 Phase diagram and oxygen stoichiometry of Y-Ba-Cu-O thin films. Yang, K.Y.; Homma, H.; Lee, R.; Bhadra, R.; Grimsditch, M.; Bader, S.D.; Locquet, J.P.; Bruynseraede, Y.; Schuller, I.K. (Materials Science Division, Argonne National Laboratory, Argonne, Illinois 60439). *Applied Physics Letters;* 53: No. 9, 808-810(29 Aug 1988).

We have performed an exhaustive study of the phase diagram of Y-Ba-Cu-O thin films using chemical analysis, energy dispersive x-ray spectroscopy, Auger electron spectroscopy, and x-ray diffraction. We show that Raman scattering can provide information regarding impurity phases and oxygen stoichiometry in thin films

46939 Magnetic flux noise in thin-film rings of YBa_2Cu_3O/sub 7-//sub δ/. Ferrari, M.J.; Johnson, M.; Wellstood, F.C.; Clarke, J.; Rosenthal, P.A.; Hammond, R.H.; Beasley, M.R. (Department of Physics, University of California, Center for Advanced Materials, Lawrence Berkeley Laboratory, Berkeley, California 94720). *Applied Physics Letters;* 53: No. 8, 695-697(22 Aug 1988).

The low-frequency magnetic flux noise in thin-film rings of YBa_2Cu_3O/sub 7-//sub δ/ (YBCO) is measured over the temperature range 1.3—125 K by means of a dc superconducting quantum interference device (SQUID) maintained at liquid-helium temperatures. Below the transition temperature T/sub c/ of the YBCO, the spectral density of the noise scales as 1/f, where f is the frequency, and generally increases with increasing temperature. The magnitude of the noise depends strongly on the microstructure of the film, and is lowest for a sample which is predominantly oriented with its c axis perpendicular to the substrate. These results imply that SQUID's and flux transformers of YBCO must be fabricated from highly oriented films to produce good resolution at low frequencies.

46940 Optical and analytical transmission-electron-microscopy studies of thermochemically reduced MgO crystals. Ballesteros, C.; Gonzalez, R.; Pennycook, S.J.; Chen, Y. (Departamento de Fisica del Estado Solido, Facultad de Ciencias Fisicas, Universidad Complutense, 28040 Madrid, Spain). *Physical Review* [*Section*] *B: Condensed Matter;* 38: No. 6, 4231-4238(15 Aug 1988).

MgO crystals from five sources were thermochemically reduced at high temperatures. Optical-absorption measurements indicated that anion vacancies were present in all of the crystals. In addition, crystal darkening was observed and was due to a broad absorption in the visible region. The dark coloration was impurity related. Analytical transmission-electron-microscopy techniques indicated the presence of metallic precipitates that were primarily Fe in content. Microdiffraction patterns indicated that the precipitates possessed the fcc (a_0 = 3.61 A) or the bcc (a_0 = 2.89 A) crystal structure. The fcc precipitates were found to have a matrix relationship of <001>/sub p/parallel<001>/sub m/ and <010>/sub p/parallel<010>/sub m/. The bcc precipitates were found to have a relationship of <001>/sub p/parallel<001>/sub m/ and <110>/sub p/parallel<010>/sub m/.

46941 Time-resolved x-ray scattering study of ordering and coarsening in Cu_3Au. Nagler, S.E.; Shannon R.F. Jr.; Harkless, C.R.; Singh, M.A.; Nicklow, R.M. (Department of Physics, University of Florida, Gainesville, Florida 32611). *Physical Review Letters;* 61: No. 6, 718-721(8 Aug 1988).

The kinetics of ordering and coarsening in single-crystal Cu_3Au are studied by use of time-resolved x-ray scattering. After quenching from high temperatures to fixed temperatures below the order-disorder temperature three regimes are apparent: nucleation, ordering, and coarsening. The superlattice peaks are anisotropic, reflecting the domain structure. The line shape of the scattering function changes with time during the crossover from the ordering to the coarsening regime. The late-stage coarsening is consistent with curvature-driven growth.

46942 Spin dynamics in the square-lattice antiferromagnet. Auerbach, A.; Arovas, D.P. (Physics Department, Brookhaven National Laboratory, Upton, New York 11973). *Physical Review Letters;* 61: No. 5, 617-620(1 Aug 1988).

We apply the Schwinger boson mean-field theory to the square-lattice Heisenberg antiferromagnet at low temperatures. For spin (1/2 we confirm the renormalized classical behavior of the correlation length κ/sup -1/(T) without appealing to spin-wave theory. We also present a detailed calculation of the dynamical structure factor. A quasielastic peak is featured near q = (π,π), while for chemical bondq-(π,π)chemical bond>>κ, spin-wave ridges appear. The uniform susceptibility interpolates between spin-wave results at T = 0 and the high-temperature series of Rushbrooke and Wood. Our theory is distinct from theories in which fermionic spinon excitations determine the low-temperature spin dynamics.

46943 Superconducting properties of VN/sub x/ sputtered films including spin fluctuations and radiation damage of stoichiometric VN. Gray, K.E.; Kampwirth, R.T.; Capone D.W. II; Vaglio, R.; Zasadzinski, J. (Materials Science Division, Argonne National Laboratory, Argonne, Illinois 60439). *Physical Review [Section] B: Condensed Matter;* **38**: No. 4, 2333-2341(1 Aug 1988).

We have made well-ordered, stoichiometric films of VN using reactive sputtering and studied the effects of disordering due to deviations from stoichiometry and radiation damage. An unexpected local minimum of T/sub c/ for the well-ordered, stoichiometric VN was found. The principal result was that the peak in T/sub c/ for substoichiometric VN/sub 0.96/ can be shown to be consistent with a competition between spin fluctuations and electron—phonon coupling, but we find the effect of the former is smaller than previously predicted. The superconducting properties measured in radiation-damaged VN have been extrapolated to pure, stoichiometric VN.

46944 Electronic structure of $LiBeH_3$. Press, M.R.; Rao, B.K.; Jena, P. (Physics Department, Virginia Commonwealth University, Richmond, Virginia 23284-2000). *Physical Review [Section] B: Condensed Matter;* **38**: No. 4, 2380-2387(1 Aug 1988).

Using a molecular-cluster representation, we have studied the equilibrium lattice spacing and the electronic structure of $LiBeH_3$. The former was obtained by minimizing the total Hartree-Fock energies of a number of clusters consisting of up to 15 atoms in a simple cubic as well as a modified perovskite structure. The resulting lattice constant is found to be in fair agreement with the value obtained by Overhauser from an analysis of the powder-diffraction data. The electronic structure of the hydride was investigated by calculating the partial and total density of states, electron-charge density distribution, and ionic character of the constituent atoms in clusters of up to 27 atoms using the local-density-functional theory. The lack of a prominent structure in the density of states at the Fermi energy and the evidence of directional bonding from the electron density map imply that $LiBeH_3$ does not have as much metallic character as previously expected. Thus, the system may not be a high-temperature superconductor if dependent upon conventional mechanisms. The density of states of $LiBeH_3$, on the other hand, bears a strong resemblance to those of the new high-T/sub c/ materials.

46945 Phenomenology of high-T/sub c/ oxides: New kind of anisotropic superconductors. Tes-hacekanovic, Z. (Theoretical Division, MS B262, Los Alamos National Laboratory, Los Alamos, New Mexico 87545). *Physical Review [Section] B: Condensed Matter;* **38**: No. 4, 2489-2493(1 Aug 1988).

We propose that in oxide superconductors there is a substantial difference between the degree of anisotropy in the single- and two-particle motion. This explains several recent experimental observations. The Cooper pairs are primarily made up of the electrons in the same Cu-O layer, but they have a significant chance of coherently hopping to the neighboring layer. Such a process arises through the interband scattering due to interactions. This has important consequences for the phenomenology of superconducting and normal states.

46946 Anisotropy of the lower critical field, magnetic penetration depth, and equilibrium shielding current in single-crystal YBa_2Cu_3O/sub 7-//sub δ/. Umezawa, A.; Crabtree, G.W.; Liu, J.Z.; Moran, T.J.; Malik, S.K.; Nunez, L.H.; Kwok, W.L.; Sowers, C.H. (Materials Science Division, Argonne National Laboratory, Argonne, Illinois 60439). *Physical Review [Section] B: Condensed Matter;* **38**: No. 4, 2843-2846(1 Aug 1988).

Magnetization measurements at 11 K are used to obtain anisotropic $H/sub\ c/_1$ values for fields along the c direction and in the basal plane of single crystals of YBa_2Cu_3O/sub 7-//sub δ/. The anisotropic magnetic penetration depth and equilibrium shielding currents at $H/sub\ c/_1$ are derived and analyzed within effective-mass theory.

46947 Synthesis and superconducting critical temperature of YBa_2Cu_3 /sup 18/O/sub 7-//sub δ/. Garcia, E.; Ryan, R.R.; Sauer, N.N.; Fisk, Z.; Pierce, B.; Fluss, M.; Bernardez, L. (Los Alamos National Laboratory, Los Alamos, New Mexico 87545). *Physical Review [Section] B: Condensed Matter;* **38**: No. 4, 2900-2902(1 Aug 1988).

YBa_2Cu_3 /sup 18/O/sub 7-//sub δ/ (90% /sup 18/O, 44% /sup 18/O) has been synthesized from the elements in order to minimize the possibility of preferential substitution at different crystallographic sites. Magnetic-flux exclusion measurements show that the T/sub c/ of the substituted material shifts by no more than ~0.2 K from the material synthesized with natural-abundance O_2.

46948 High-temperature Raman measurements of single-crystal YBa_2Cu_3O/sub 7-//sub x/. McCarty, K.F.; Hamilton, J.C.; Shelton, R.N.; Ginley, D.S. (Sandia National Laboratories, Livermore, California 94550). *Physical Review [Section] B: Condensed Matter;* **38**: No. 4, 2914-2917(1 Aug 1988).

We report in situ Raman spectra from single-crystal YBa_2Cu_3O/sub 7-//sub x/ in oxygen at temperatures from 20 to 770 °C and from YBa_2Cu_3O/sub 6.2/ in argon at temperatures from 20 to 545 °C. For YBa_2Cu_3O/sub 7-//sub x/ in oxygen, a defect-induced phonon at ~570 cm/sup -1/ appears above ~500 °C and increases in intensity with increasing temperature and loss of oxygen. As YBa_2Cu_3O/sub 6.2/ is heated above ~100 °C, dramatic changes occur in the phonon bands, resulting from three-dimensional reorganization (disordering) of the oxygen in the structure involving the formation of oxygen vacancies at the O(4) sites.

46949 X-ray spectroscopy of $EuBa_2$(Cu/sub 1-//sub y/Zn/sub y/)$_3O$/sub 7-//sub x/: Suppression of superconductivity. Horn, S.; Reilly, K.; Fisk, Z.; Kwok, R.S.; Thompson, J.D.; Borges, H.A.; Chang, C.L.; denBoer, M.L. (Physics Department, New York University, 4 Washington Place, New York, New York 10003). *Physical Review [Section] B: Condensed Matter;* **38**: No. 4, 2930-2933(1 Aug 1988).

We have studied the x-ray-absorption near-edge spectra of $EuBa_2$(Cu/sub 1-//sub y/Zn/sub y/)$_3O_7$ as a function of Zn and O content. There is clear evidence for the development of Cu/sup 1+/ ions as the O content is reduced to levels sufficient to suppress superconductivity. However, there is no effect on the electronic state of the Cu ion as the Zn content is increased and superconductivity vanishes. We tentatively conclude that the suppression of superconductivity is in both cases due to the preferred occupancy of certain planes by nonmagnetic (filled d subshell) atoms, as proposed in $YBa_2Cu_3O_6$ on the basis of neutron scattering.

46950 Magnon pairing mechanism of superconductivity in cuprate ceramics. Chen, G.; Goddard, W.A. III. (California Institute of Technology, Pasadena (USA)). *Science (Washington, D.C.);* **239**: 899-902(19 Feb 1988).

The magnon pairing mechanism is derived to explain the high-temperature superconductivity of both the La/sub 2-x/Sr/sub x/CuO_4 and $YBa_2Cu_3O_7$ systems. Critical features include (i) a one- or two-dimensional lattice of linear Cu-O-Cu bonds that contribute to large antiferromagnetic (superexchange)coupling of the Cu/sup II/ (d^9) orbitals; (ii) holes in the oxygen ppi bands [rather than Cu/sup III/ (d^8)] leading to high mobility hole conduction; and (iii) strong ferromagnetic coupling between oxygen ppi holes and adjacent Cu/sup II/(d^9) electrons. The ferromagnetic coupling of the conduction electrons with copper d spins induces the attractive interaction responsible for the superconductivity, leading to triplet-coupled pairs called tripgems. The disordered Heisenberg lattice of antiferromagnetically coupled copper d spins serves a role analogous to the phonons in a conventional system. This leads to a maximum transition temperature of about 200 K. For La/sub 1.85/Sr/sub 0.15/Cu_3O_4, the energy gap is in excellent agreement with experiment. For $Y_1Ba_2Cu_3O_7$, is was noted that both the CuO sheets and the CuO chains can contribute to the supercurrent. 18 references.

40951 Effects of ion implantation on the mechanical properties of ceramics. McHargue, C.J. (Oak Ridge National Lab., TN (USA)). *Transactions of the American Nuclear Society;* 55: 261-262(1987). (CONF-8711195—).

From American Nuclear Society winter meeting; Los Angeles, CA, USA (15 Nov 1987).

The mechanical properties of ceramics are most sensitive to surface conditions than is the case for most other classes of structural materials. Most failures of high-quality ceramic components under applied loads originate at the surface. A failure generally is initiated by a tensile component of the applied stress or by the propagation of a preexisting flaw, or a combination of these factors. As a consequence, the useful strengths of such materials can often be raised by surface treatments, which remove the flaws or reduced their severity, or which generate a compressive stress layer at the surface. Recently there have been a number of studies of the effects of ion implantation on the surface mechanical properties of ceramics. Although much of the data is only qualitative because of the difficulties of accurate determination of the properties of thin layers, it is clear that significant changes in hardness, apparent fracture toughness, rupture strength, and tribological properties may be caused by ion implantation.

40952 Microstructure development in SI/sub 3/N/sub 4/-based composites. Buljan, S.T.; Zilberstein, G. (GTE Labs. Inc., 40 Sylvan Road, Waltham, MA (US)). pp 273-282 of Advanced structural ceramics. Becher, P.F.; Swain, M.V.; Somiya, S. Pittsburgh, PA; Materials Research Society (1987). (CONF-861207—).

From Materials Research Society fall meeting; Boston, MA, USA (1 Dec 1986).

The success and predictability of mechanical property improvements in ceramic matrix composites strongly depends on the ability to generate specific spacial arrangements and maintain the properties of the constituents. Dispersoids added to improve the toughness and strength of the ceramic base can mechanically or chemically alter the development of the matrix microstructure during consolidation and cause the properties to deviate from expected values. The present study examines and compares the development of a Si/sub 3/N/sub 4/-based composite microstructure with the chemically "active" TiC and "inert" SiC dispersoids; it further examines the effect of the resulting microstructures on the composite fracture toughness.

40953 Deformation behavior of SiC whisker reinforced Si/sub 3/N/sub 4/. Nixon, R.D.; Chevacharoenkul, S.; Buckabee, M.L.; Buljan, S.T.; Davis, B.F. (North Carolina State Univ., Raleigh, NC (US)). pp 295-302 of Advanced structural ceramics. Becher, P.F.; Swain, M.V.; Somiya, S. Pittsburgh, PA; Materials Research Society (1987). (CONF-861207—).

From Materials Research Society fall meeting; Boston, MA, USA (1 Dec 1986).

Constant compressive stress creep experiments in the temperature and stress ranges of 1420K - 1570K and 50 MN/m/sup 2/ - 350 MN/m/sup 2/ have been conducted on hot pressed unreinforced Si/sub 3/N/sub 4/ containing the densification aids of 6 wt% Y/sub 2/O/sub 3/ and 1.5 wt% Al/sub 2/O/sub 3/ and on a similarly prepared composite material reinforced with 20 vol% SiC whiskers. Steady-state creep data obtained on these materials in a N/sub 2/ atmosphere gave stress exponent values of 1.2 - 1.6 and 0.4 - 1.6 for the unreinforced Si/sub 3/N/sub 4/ and the composite, respectively. A break in the steady-state creep rate vs. log stress observed only in the composite occurred at approximately 250 MN/m/sup 2/ at the temperatures of 1520K and 1570K. This information coupled with the results of electron microscopy indicate that the temperature as well as the extensive crystallization (or lack of it) of the amorphous grain boundary phase are the principal factors controlling the deformation rate at a given stress within the limits of the small total strains achieved in this research.

40954 Strain and fracture in whisker reinforced ceramics. Angelini, P.; Mader, W.; Becher, P.F. (Oak Ridge National Lab., P.O. Box X, Oak Ridge, TN (US)). pp 241-258 of Advanced structural ceramics. Becher, P.F.; Swain, M.V.; Somiya, S. Pittsburgh, PA; Materials Research Society (1987). (CONF-861207—).

From Materials Research Society fall meeting; Boston, MA, USA (1 Dec 1986).

Whisker reinforced ceramics offer the potential for increased fracture strength and toughness. However, residual strain due to the thermal expansion mismatch between Al/sub 2/O/sub 3/ and SiC may affect mechanical properties of such composites. Crack tip interaction with the whisker/matrix may lead to changes in debonding behavior or influence other toughening mechanisms. The strain field in the Al/sub 2/O/sub 3/ matrix surrounding SiC whiskers was analyzed with a High Voltage Transmission Electron Microscope (HVEM). Strain contrast oscillations indicating the presence of residual stress in the specimen were observed in a Al/sub 2/O/sub 3/-5 vol % SiC composite having $\approx$ 15 μm grain size. The strain field was found to have both radial (perpendicular to whisker axis) and axial (parallel to whisker axis) components. A strain field was also present near the end faces of SiC whiskers. In situ thermal annealing to 573, 873, and 1173 K showed a decrease in the residual strain while in situ cooling to $\approx$ 77 K revealed little change in the strain. These results show that residual stresses in the compacts result from differences in thermal expansion and elastic constants of the matrix and whisker materials. Dynamic in situ fracture experiments performed in an HVEM on the Al/sub 2/O/sub 3/-5 vol % SiC material having $\approx$ 15 μm as well as on Al/sub 2/O/sub 3/-20 vol % SiC having $\approx$ 1 μm grain size revealed that fracture resistance is due to a number of mechanisms including debonding near the whisker matrix interface, crack deflection, pinning, and bridging by SiC whiskers. Formation of secondary fractures and microcracks near and in front of propagating crack tips was also observed in the larger grain size composite.

40955 Interfacial characterizations of fiber-reinforced SiC composites exhibiting brittle and toughened fracture behavior. Rawlins, M.H.; Nolan, T.A.; Stinton, D.P.; Lowden, R.A. (Oak Ridge National Lab., Oak Ridge, TN (US)). pp 223-230 of Advanced structural ceramics. Becher, P.F.; Swain, M.V.; Somiya, S. Pittsburgh, PA; Materials Research Society (1987). (CONF-861207—).

From Materials Research Society fall meeting; Boston, MA, USA (1 Dec 1986).

A process has been developed for the fabrication of a ceramic composite of SiC fibers in a chemical vapor infiltrated (CVI) SiC matrix. Early specimens produced by this technique exhibited nonuniform fracture toughness behavior; regions of brittle fracture with no fiber pullout were interspersed with regions of good toughness where fiber pullout predominated. Microscopic and spectroscopic analyses of fiber surfaces revealed that this behavior may have been related to a thin, discontinuous layer of predominantly silica which, when present, prevented tight bonding of fibers and CVI matrix. Consequently, efforts to control interfacial bond strengths and enhance fracture toughness via fiber pretreatment with CVI overcoatings have had mixed success depending upon the overcoating specie. Chemical and microstructural characterizations by analytical electron microscopy of these composites are presented and correlated with composite mechanical property data.

40956 Erosion of a silicon carbide whisker reinforced silicon nitride. Morrison, C.T.; Routbort, J.L. (Dept. of Materials Engr., North Carolina State Univ., Raleigh, NC (US)). pp 207-214 of Advanced structural ceramics. Becher, P.F.; Swain, M.V.; Somiya, S. Pittsburgh, PA; Materials Research Society (1987). (CONF-861207—).

From Materials Research Society fall meeting; Boston, MA, USA (1 Dec 1986).

The steady-state solid particle erosion behavior of hot-pressed Si/sub 3/N/sub 4/ reinforced with 0,10, and 20 weight percent SiC whiskers has been investigated at room temperature using angular alumina particles (63 to 270μm diameter)as the erodent. The impact angle was varied from 30 to 90/sup 0/ and particle velocities were varied from 80 to 140 m/s. These materials were found to be very erosion resistant. However, there was little effect of the SiC whisker reinforcement on either the absolute erosion rate or on the velocity or particle-size exponents for the rates. The lack of a fiber reinforcement effect occurs even though the fiber additions provide an increase in the fracture toughness at high fiber contents. Results on differently processed Si/sub 3/N/sub 4/ base materials showed that microstructural variations due to processing

history have a very significant influence on the erosion resistance of the base (matrix) material. The results substantiate the idea that microstructure plays an important, but not fully understood role in the erosion processes for brittle materials.

46957 **Strength and interfacial properties of ceramic composites.** Marshall, D.B. (Rockwell International Science Center, 1049 Camino Dos Rios, Thousand Oaks, CA (US)). pp 175-180 of Advanced structural ceramics. Becher, P.F.; Swain, M.V.; Somiya, S. Pittsburgh, PA; Materials Research Society (1987). (CONF-861207—).

From Materials Research Society fall meeting; Boston, MA, USA (1 Dec 1986).

Results of recent micromechanics analyses of the reinforcing influence of frictionally bonded fibers in ceramic composites are summarized. Direct measurements of the fiber/matrix interface properties are also discussed.

46958 **Strength improvement in transformation toughened ceramics using compressive residual surface stresses.** Cutler, R.A.; Hansen, J.J.; Virkar, A.V.; Shetty, D.K.; Winterton, R.C. (Ceramatec, Inc., 2455 S 900 W, Salt Lake City, UT (US)). pp 155-164 of Advanced structural ceramics. Becher, P.F.; Swain, M.V.; Somiya, S. Pittsburgh, PA; Materials Research Society (1987). (CONF-861207—).

From Materials Research Society fall meeting; Boston, MA, USA (1 Dec 1986).

Al/sub 2/O/sub 3/-15 vol. % ZrO/sub 2/ bar shaped composite specimens were fabricated by pressing three layers. The two outer layers consisted of Al/sub 2/O/sub 3/ and unstabilized ZrO/sub 2/ (primarily in the monoclinic polymorph), and the inner layer consisted of Al/sub 2/O/sub 3/ and partially stabilized zirconia in the tetragonal polymorph. The transformation of ZrO/sub 2/ from tetragonal to monoclinic, upon cooling from sintering temperature, led to the establishment of residual compressive streses in the outer layers. Flexural tests at room temperature showed that residual stresses contributed to strength increasing from 450 to 825 MPa. The existence of these stresses was verified by measuring apparent fracture toughness, as well as using strain gages. Strength and toughness data were obtained at 500, 750, and 1000/sup 0/C. X-ray diffraction was used to explain the elevated temperature data by monitoring the monoclinic to tetragonal transformation upon heating to 1000/sup 0/C.

46959 **Advanced structural ceramics.** Becher, P.F.; Swain, M.V.; Somiya, S. Pittsburgh, PA; Materials Research Society (1987). 306p. (CONF-861207—). Materials Research Society, 9800 Mc Knight Rd., Suite 327, Pittsburgh, PA 15237.

From Materials Research Society fall meeting; Boston, MA, USA (1 Dec 1986).

This book contains papers under the following headings: transformation analysis; transformation plasticity and toughness; mechanical properties and microstructures of zirconia toughened ceramics; mechanical behavior of reinforced ceramic composites; and fracture and deformation behavior in ceramic composites.

3606 Other Materials

REFER ALSO TO CITATION(S) 46273, 46496, 46754, 46759, 46761, 46835, 46861, 46866, 46867, 46868, 46869, 46917, 46919, 47082, 47109, 47156, 47193, 47193, 47199, 47201, 47202, 47203, 47204, 47205, 47206, 47207, 47208, 47273, 47672, 47874, 47886

46960 **(BNL—41473) Spin structure and magnetic excitations in a 2D xy ferromagnet: $CoCl_2$-intercalated graphite.** Wiesler, D.G.; Zabel, H.; Shapiro, S.M. (Brookhaven National Lab., Upton, NY (USA)). 1988. Contract AC02-76CH00016. 11p. (CONF-880715—2). NTIS, PC A03/MF A01; 1; GPO Dep. Order Number DE88013992/JAW.

From 4. international conference on neutron scattering (ICNS '88); Grenoble, France (12 Jul 1988).

We have investigated the magnetic excitations in stage-2 $CoCl_2$-intercalated graphite, which approximates a two-dimensional xy ferromagnet. As T increases the low-q spin waves disappear without renormalizing continuously to zero. In addition a central peak is present, the q- and T-dependence of which suggest the presence of spin vortices. 7 refs., 4 figs.

46961 **(CEGB-TPRD/B—1041/R88) Study of the pore-size distributions of some virgin Oldbury test-well graphites.** Bahia, A.; Bowden, E.A.T. (Central Electricity Generating Board, Berkeley (UK). Berkeley Nuclear Labs.). Feb 1988. 16p. NTIS (US Sales Only), PC A03/MF A01. Order Number DE88754278/JAW.

The pore-size distributions of some virgin Oldbury test-well graphite specimens have been determined using both image analysis and mercury porosimetry. Image analysis has revealed that the pore-size distribution (PSD) is not a function of distance from the channel wall (fuel and interstitial). Differences found between the PSDs of individual specimens have led to predicted weight losses which exhibit a variability similar to that found in installed-specimen data. The results, therefore, confirm that the channel wall densification is unlikely to be pore related, but rather to be due to short-range inhibition in the gas phase.

46962 **(CONF-8804114—5) Growth and structure of pyrogenic silica.** Schaefer, D.W.; Hurd, A.J.; Christen, D.K.; Spooner, S.; Lin, J.S. (Sandia National Labs., Albuquerque, NM (USA); Oak Ridge National Lab., TN (USA)). Jun 1988. Contract AC05-84OR21400;AC04-76DP00789. 7p. NTIS, PC A02/MF A01; 1; GPO Dep. Order Number DE88013844/JAW.

From Better ceramics through chemistry III; Reno, NV, USA (5 Apr 1988).

Fractal analysis is used to interpret small-angle X-ray and neutron scattering data on commercial fumed silica powders. Rough primary particles are found in high surface area powders. A model based on ballistic polymerization, sintering, and diffusion-limited aggregation is proposed to explain the observed powder structure. 13 refs., 6 figs.

46963 **(DOE/ER/45161—T1) Low stress brittle fractures in polymers: Progress report, August 1, 1987--August 1, 1988.** Brown, N. (Pennsylvania Univ., Philadelphia (USA). Dept. of Materials Science and Engineering). 1988. Contract FG02-84ER45161. 8p. NTIS, PC A02/MF A01. Order Number TI88014236/JAW.

The results of the effect of molecular parameters show: (1) that crack resistance varies as (M/sub w/--M_o) for PE where M/sub w/ is weight average molecular weight and M_o--20,000; (2) butyl branches are more effective than ethyl; (3) crack resistance increases with branch density; (4) there is an unknown factor that increases crack resistance even if molecular weight and branch density is the same. Fundamental parameters such as the stress distribution on the boundary of the process zone can now be measured. The activation energy of slow crack growth for different types of polyethylene range from 83-115 KJ/mol. The basic research data is being applied toward the prediction of the life-time of the 200,000 miles of polyethylene gas pipe that is now in service in the United States.

46964 **(DOE/ER/45271—T2) Molecular ferromagnetism: Progress report.** Epstein, A.J. (Ohio State Univ., Columbus (USA)). 6 Jun 1988. Contract FG02-86ER45271. 5p. NTIS, PC A02/MF A01; 1; GPO Dep. Order Number DE88013750/JAW.

Progress has occurred in the area of controlled synthesis of molecular and polymeric materials, characterization of the magnetic properties of these materials, and the development of models of the magnetic state in these materials, as well as the models for the origins of the ferromagnetic or antiferromagnetic exchange in these systems. In particular, we have synthesized 4,4'-(butadiyne-1,4-diyl)-bis-(2,2,6,6,-tetramethyl-4-hydroxypiperidin-1-oxyl) (BIPO), and carried out extensive studies of the transformations that occur. Also, neutron diffraction studies of the deuterated decamethylferrocenium TCNE compound have been performed.

46965 **(DOE/ER/60416—T1) Development of advanced internal gain radiation detector structures based on neutron transmutation doped silicon, High T/sub c/ superconductive compounds and their potential application to detection of ionizing radiation: Annual report, December 1, 1986-November 30, 1987.** Huth, G.C.; Zhou, Bing-Lin; Prussin, S.; Dabrowski, A.J. (University of Southern California, Marina Del Rey (USA). Inst. of Physics). 1987. Contract FG03-86ER60416. 27p. NTIS, PC A03/MF A01; 1; GPO Dep. Order Number DE88012563/JAW.

This report covers the period of work from December 1, 1986 through November 30, 1987. The work on mercuric iodide has now entered a new and more developmental phase with support now being obtained from other agencies (NIH, NASA, JPL, the CalTech President's Fund etc.) for specific, directed applications. These include development of arrays of HgI_2 x-ray spectrometers for synchrotron radiation application supported by NIH and for long term space mission use supported by NASA. It has been undertaken during the past year (with some work done in the previous year) to re-examine the technology of high field "avalanche" radiation detector structures which use the "controlled surface" principle as developed previously under DOE sponsorship. This was undertaken because of the advent of a fundamental advance in silicon single crystal technology -"neutron transmutation doped" or "NTD" single crystal. This new material conceptually solves a basic problem that previously halted the development of these potentially useful radiation detection structures. That problem was the non-uniform, (or "striated") distribution of donor impurities which adversely affected electric field distribution and thus attainable avalanche gain in these structures. A new effort started late in the year springs from the development of high critical temperature superconducting ceramic compounds. In essence, the phenomenon of superconductivity can now be achieved at temperatures reached by liquid nitrogen rather than expensive and more complicated cryogenic helium. This, in essence, then brings superconductivity into the same temperature range where lithium drifted silicon and intrinsic germanium already operate. The usefulness of superconductivity in detection and spectroscopy of ionizing radiations based on the narrow superconductive band gap is very appealing and we have begun theoretical (presented herein) and experimental studies investigating these new materials.

46966 **(EGG—10282-2140) Preparation and evaluation of mercuric iodide for crystal growth.** Skinner, N.L.; Ortale, C.; Schieber, M.M. (EG and G Energy Measurements, Inc., Goleta, CA (USA). Santa Barbara Operations). 1988. Contract AC08-83NV10282. 15p. (CONF-8709315—4; S—325-TP). NTIS, PC A03/MF A01; 1; GPO Dep. Order Number DE88014981/JAW.

From 6. international workshop on compound semiconductors for room temperature X-ray and nuclear detectors; Davos, Switzerland (14 Sep 1987).

Large quantities, on the order of several hundred, of consistent, high quality mercuric iodide for crystal growth have not been commercially available. The hydrocarbon, anion, and cation impurity levels varied considerably, occasionally preventing crystal growth. This occurred even though the starting materials was from the same vendor and was subjected to the same purification treatment. This paper will describe an aqueous precipitation process of mercuric iodide preparation in batches of 3 kg using $Hg(NO_3)_2$ or $HgCl_2$and KI. Since these salts are produced in much larger quantities than mercuric iodide, more consistent quality is available. The impurity content of these batched and single crystals are compared. Some of the single crystals grown using the in-house prepared mercuric iodide have yielded a large number of spectroscopy grade nuclear radiation detectors. The influence of the major impuritites are discussed. 13 refs., 4 figs., 1 tab.

46967 (INIS-BR—1157, pp 30) **CuInTe/sub 2/ devices by chemical substitution technique.** Grima G, P.; Bellabarba, C.; Gonzalez, J.; Sanchez, G. (Universidad de Los Andes, Merida (Venezuela)). 1981. (In Spanish). NTIS (US Sales Only), PC A06/MF A01. Order Number DE88703560/JAW. (CONF-8109291—).

From 7. Latin American symposium on solid state physics; Gramado, Brazil (14 Sep 1981).

46968 (INIS-BR—1157, pp 114) **Electroplastic effect in V/sub 3/Si.** San Martini U, A.; Paufler, P.; Kleinstuck, K. 1981. (In Spanish). NTIS (US Sales Only), PC A06/MF A01. Order Number DE88703560/JAW. (CONF-8109291—).

From 7. Latin American symposium on solid state physics; Gramado, Brazil (14 Sep 1981).

46969 (INIS-BR—1157, pp 22) **Magnetic properties of CuGaX/sub 2/ type semiconductors.** Sagredo, V. (Universidad de Los Andes, Merida (Venezuela)). 1981. (In Spanish). NTIS (US Sales Only), PC A06/MF A01. Order Number DE88703560/JAW. (CONF-8109291—).

From 7. Latin American symposium on solid state physics; Gramado, Brazil (14 Sep 1981).

46970 (INIS-BR—1157, pp 24) **Energy gap Eg in the mixed Cd/sub x/Zn/sub 1-x/S.** Khater, A.F. (Universidade Federal Fluminense, Niteroi (Brazil). Inst. de Fisica). 1981. NTIS (US Sales Only), PC A06/MF A01. Order Number DE88703560/JAW. (CONF-8109291—).

From 7. Latin American symposium on solid state physics; Gramado, Brazil (14 Sep 1981).

46971 (INIS-BR—1157, pp 27) **Photoluminescence and excitation spectra of deep levels in ZnSe: In.** Meneses, E.A. de; Buriti, A.C.; Motisuke, P. (Universidade Federal Fluminense, Niteroi (Brazil). Inst. de Fisica). 1981. (In Portuguese). NTIS (US Sales Only), PC A06/MF A01. Order Number DE88703560/JAW. (CONF-8109291—).

From 7. Latin American symposium on solid state physics; Gramado, Brazil (14 Sep 1981).

46972 (INIS-BR—1157, pp 29) **Measurements of photoluminescence in InP and InGaAsP crystals.** Mendoza A, J.G.; Torres D, G. (Instituto Politecnico Nacional, Mexico City. Escuela Superior de Fisica y Matematicas). 1981. (In Spanish). NTIS (US Sales Only), PC A06/MF A01. Order Number DE88703560/JAW. (CONF-8109291—).

From 7. Latin American symposium on solid state physics; Gramado, Brazil (14 Sep 1981).

46973 (INIS-BR—1157, pp 31) **Optical properties of CuInSe/sub 2/ in the fundamental absorption region.** Rincon, C.; Gonzalez, J.; Sanchez P, G. (Universidad de Los Andes, Merida (Venezuela)). 1981. (In Portuguese). NTIS (US Sales Only), PC A06/MF A01. Order Number DE88703560/JAW. (CONF-8109291—).

From 7. Latin American symposium on solid state physics; Gramado, Brazil (14 Sep 1981).

46974 (INIS-BR—1157, pp 52) **TDPAC study of quadrupolar interactions in K/sub 2/ZrF/sub 6/.** Martinez, J.A.; Caracoche, M.A.; Lopes G, A.R.; Mercader, R.C.; Rodriguez, A.M. (La Plata Univ. Nacional (Argentina)). 1981. (In Spanish). NTIS (US Sales Only), PC A06/MF/A01. Order Number DE88703560/JAW. (CONF-8109291—).

From 7. Latin American symposium on solid state physics; Gramado, Brazil (14 Sep 1981).

46975 (INIS-BR—1157, pp 104) **Thermoelectric power of Sn-Te alloy.** Kurlat, D.H. (Facultad de Ingenieria, Buenos Aires (Argentina)). 1981. (In Spanish). NTIS (US Sales Only), PC A06/MF A01. Order Number DE88703560/JAW. (CONF-8109291—).

From 7. Latin American symposium on solid state physics; Gramado, Brazil (14 Sep 1981).

46976 (INIS-BR—1157, pp 107) **Electric conductivity of CuInTe/sub 2/ annealed in the Cu, In, Zn and Cd saturated vapor.** Sanchez P, G.; Wasim, S. (Universidad de Los Andes, Merida (Venezuela)). 1981. (In Spanish). NTIS (US Sales Only), PC A06/MF A01. Order Number DE88703560/JAW. (CONF-8109291—).

From 7. Latin American symposium on solid state physics; Gramado, Brazil (14 Sep 1981).

46977 (INIS-BR—1157, pp 108) **Electric properties and thermal conductivity of the AgInTe/sub 2/ ternary semiconductor.** Bellabarba, C.; Wasim, S.M.; Gonzalez, J. (Universidad de Los Andes, Merida (Venezuela)). 1981. (In Spanish). NTIS (US Sales Only), PC A06/MF A01. Order Number DE88703560/JAW. (CONF-8109291—).

From 7. Latin American symposium on solid state physics; Gramado, Brazil (14 Sep 1981).

46978 (INIS-BR—1157, pp 60) **Magnetic properties in Cd/sub 1-x/ Mn/sub x/ Te and Cd/sub 1-x/ Mn /sub x/Se concentrated glass.** Oseroff, S. 1981. (In Spanish). NTIS (US Sales Only), PC A06/MF A01. Order Number DE88703560/JAW. (CONF-8109291—).

From 7. Latin American symposium on solid state physics; Gramado, Brazil (14 Sep 1981).

46979 (INIS-BR—1164, pp 37) **Epitaxial growth of the In/sub 1-x/ Ga/sub x/As/sub y/P/sub 1-y/ alloy in non planar surfaces.** Carvalho Junior, W.; Caumo, J.R. (TELEBRAS, Campinas (Brazil). Centro de Pesquisas). 1987. (In Portuguese). NTIS (US Sales Only), PC A09/MF A01. Order Number DE88703566/JAW. (CONF-8705181—).

From 10. national meeting on condensed matter physics; Caxambu, Brazil (5 May 1987).

46980 (INIS-BR—1164, pp 46) **Epitaxy growth of InGaAsP with low saturation: possible application in quantum wells.** Caumo, J.R.; Carvalho Junior, W. (TELEBRAS, Campinas (Brazil). Centro de Pesquisas). 1987. (In Portuguese). NTIS (US Sales Only), PC A09/MF A01. Order Number DE88703566/JAW. (CONF-8705181—).

From 10. national meeting on condensed matter physics; Caxambu, Brazil (5 May 1987).

46981 (INIS-BR—1164, pp 46) **Two annealing experiments of GaAs and InP substrates in crystal growth MOVPE atmospheres.** Sacilotti, M.A.; Castro, S.G.C. de; Masut, R.A. (TELEBRAS, Campinas (Brazil). Centro de Pesquisas; Universidade Estadual de Campinas (Brazil). Inst. de Fisica; NRC (Canada)). 1987. (In Portuguese). NTIS (US Sales Only), PC A09/MF A01. Order Number DE88703566/JAW. (CONF-8705181—).

From 10. national meeting on condensed matter physics; Caxambu, Brazil (5 May 1987).

46982 (INIS-BR—1164, pp 181) **Production and characterization of thin films of cadmium tellurides (CdTe).** Ferreira, C.L. (Instituto Militar de Engenharia, Rio de Janeiro (Brazil)). 1987. (In Portuguese). NTIS (US Sales Only), PC A09/MF A01. Order Number DE88703566/JAW. (CONF-8705181—).

From 10. national meeting on condensed matter physics; Caxambu, Brazil (5 May 1987).

46983 (INIS-BR—1164, pp 181) **Structural phase transitions under pressure: zincblend and hexagonal close packed type semiconductors.** Carrara, S.F.; Barberis, G.E. (Universidade Estadual de Campinas (Brazil). Inst. de Fisica). 1987. (In Portuguese). NTIS (US Sales Only), PC A09/MF A01. Order Number DE88703566/JAW. (CONF-8705181—).

From 10. national meeting on condensed matter physics; Caxambu, Brazil (5 May 1987).

46984 (INIS-BR—1164, pp 161) **Optical properties of semimagnetic semiconductors.** Sardela Junior, M.R.; Fazzio, A. (Sao Paulo Univ. (Brazil). Inst. de Fisica). 1987. (In Portuguese). NTIS (US Sales Only), PC A09/MF A01. Order Number DE88703566/JAW. (CONF-8705181—).

From 10. national meeting on condensed matter physics; Caxambu, Brazil (5 May 1987).

46985 (INIS-BR—1164, pp 175) **Study of Zn diffusion in In GaAs (In 53% and Ga 47%).** Sato, E.A.S.; Shieh, P.J. (TELEBRAS, Campinas (Brazil). Centro de Pesquisas). 1987. (In Portuguese). NTIS (US Sales Only), PC A09/MF A01. Order Number DE88703566/JAW. (CONF-8705181—).

From 10. national meeting on condensed matter physics; Caxambu, Brazil (5 May 1987).

46986 (INIS-BR—1164, pp 34) **Study and characterization of Saint-Terezinha of Goias emeralds.** Lariucci, C.; Almeida Santos, R.H. de. (Goias Univ., Goiania (Brazil). Dept. de Fisica; Sao Paulo Univ., Sao Carlos, SP (Brazil). Inst. de Fisica e Quimica). 1987. (In Portuguese). NTIS (US Sales Only), PC A09/MF A01. Order Number DE88703566/JAW. (CONF-8705181—).

From 10. national meeting on condensed matter physics; Caxambu, Brazil (5 May 1987).

46987 (INIS-BR—1164, pp 86) **Study of dodecyl sodium sulfate/water/decanol system.** Amaral, L.Q. do; Helene, M.E.M.; Bittencourt, D.R.S.; Itri, R. (Sao Paulo Univ. (Brazil). Inst. de Fisica). 1987. (In Portuguese). NTIS (US Sales Only), PC A09/MF A01. Order Number DE88703566/JAW. (CONF-8705181—).

From 10. national meeting on condensed matter physics; Caxambu, Brazil (5 May 1987).

46988 (INIS-BR—1164, pp 47) **Photoacoustic spectroscopy applied to transparent materials.** Bento, A.C.; Vargas, H.; D'Aguiar Neto, M.M.F.; Miranda, L.C.M. (Universidade Estadual de Campinas (Brazil). Inst. de Fisica; Bahia Univ., Salvador (Brazil). Inst. de Fisica; Instituto de Pesquisas Espaciais, Sao Jose dos Campos (Brazil)). 1987. (In Portuguese). NTIS (US Sales Only), PC A09/MF A01. Order Number DE88703566/JAW. (CONF-8705181—).

From 10. national meeting on condensed matter physics; Caxambu, Brazil (5 May 1987).

46989 (INIS-BR—1164, pp 48) **Monte Carlo simulation of the roughness transition of xenon adsorbed in palladium.** Silva, M.A.A. da; Caliri, A.; Mokross, B.J. (Sao Paulo Univ., Sao Carlos, SP (Brazil). Inst. de Fisica e Quimica). 1987. (In Portuguese). NTIS (US Sales Only), PC A09/MF A01. Order Number DE88703566/JAW. (CONF-8705181—).

From 10. national meeting on condensed matter physics; Caxambu, Brazil (5 May 1987).

46990 (INIS-BR—1164, pp 124) **Energy transfer between Pr/sup 3+/ ions in borate glass.** Pacheco, E.M.; Araujo, C.B. de. (Pernambuco Univ., Recife (Brazil). Dept. de Fisica). 1987. (In Portuguese). NTIS (US Sales Only), PC A09/MF A01. Order Number DE88703566/JAW. (CONF-8705181—).

From 10. national meeting on condensed matter physics; Caxambu, Brazil (5 May 1987).

46991 (INIS-BR—1164, pp 25) **Studies on teflon electrets by electron paramagnetic resonance.** Crestana, S. (Sao Paulo Univ., Sao Carlos, SP (Brazil). Inst. de Fisica e Quimica). 1987. (In Portuguese). NTIS (US Sales Only), PC A09/MF A01. Order Number DE88703566/JAW. (CONF-8705181—).

From 10. national meeting on condensed matter physics; Caxambu, Brazil (5 May 1987).

46992 (LA-UR—88-2265) **The intrinsic energy gap of crystalline trans-polyacetylene.** Vogl, P.; Leising, G. (Los Alamos National Lab., NM (USA)). 1988. Contract W-7405-ENG-36. 7p. (CONF-880669—11). NTIS, PC A02/MF A01; 1; GPO Dep. Order Number DE88014325/JAW.

From International conference on science and technology of synthetic metals; Santa Fe, NM, USA (26 Jun 1988).

Experimental data for the anisotropic optical conductivity of highly oriented nonfibrous trans-polyacetylene films and first-principles electronic structure calculations of crystalline 3-D trans-polyacetylene are presented. A comparison between the experimental data and the calculated density of states reveals that three-dimensional crystalline trans-polyacetylene has a direct minimum energy gap of 1.1 eV. 18 refs., 3 figs.

46993 **(LBL—25404) Far infrared linear response and radio frequency nonlinear response of charge density wave conductors and high T/sub c/ superconductors.** Sherwin, M.S. (Lawrence Berkeley Lab., CA (USA)). Jun 1988. Contract AC03-76SF00098. 189p. NTIS, PC A09/MF A01; 1; GPO Dep. Order Number DE88013595/JAW.

The far-ir (FIR) linear response of the charge-density-wave (CDW) conductor $(TaSe_4)_2I$ and polycrystalline La/sub 1.85/Sr/sub 0.15/CuO_4 and La/sub 1.85/Ca/sub 0.15/CuO_4 was measured at 8–350 cm/sup {minus}1/ and 5 to 300K. At low T in $(TaSe_4)_2I$, a mode with giant oscillator strength was found at 38 cm^{-1}. This giant FIR mode lies between the pinned mode and the Peierls gap. It is suggested that a giant FIR mode distinct from the pinned mode is a common feature of CDW conductors. At low T in the high-T/sub c/ superconductors, a reflectance edge was observed near 2.5k/sub B/T/sub c/. The BCS-like temperature-dependence of the reflectance edge is suggestive of an energy gap. However, a simple model shows that a BCS-like temperature dependence is also consistent with an interpretation of the reflectance edge as a low-frequency plasmon. It is not yet possible to deduce the energy gap from the FIR spectra. The rf nonlinear response of the CDW conductor $NbSe_3$ was also measured. In combined rf- and dc-electric fields, mode-locking occurs in $NbSe_3$. Complete mode-locking in conventional samples dramatically suppresses sliding CDW conduction fluctuations. Combined rf and dc electric fields on switching $NbSe_3$ induced a large amplitude {open←quotes}ac switching noise{close←quotes} for rf frequencies <1 MHz, and a period-doubling route to chaos for rf-frequencies >1 MHz. The mode-locking behavior of switching and nonswitching $NbSe_3$ is analyzed. A model of CDW elasticity qualitatively reproduces all of the experimental anomalies for dc-, ac- and combined ac- and dc-electric fields. It is suggested that, during mode-locking, the number of degrees of freedom active in CDW transport is reduced.

46994 **(LBL—25544) Quantum Monte Carlo calculation of the properties of atomic carbon and diamond.** Fahy, S.; Wang, X.W.; Louie, S.G. (Lawrence Berkeley Lab., CA (USA)). Jun 1988. Contract AC03-76SF00098. 6p. (CONF-880884—2). NTIS, PC A02/MF A01; 1; GPO Dep. Order Number DE88014659/JAW.

From 19. international conference on the physics of semiconductors; Warsaw, Poland (1 Aug 1988).

A new method of calculating total energies of solids using non-local pseudopotentials in conjunction with the variational quantum Monte Carlo approach is presented. By using pseudopotentials, the large fluctuations of the energies in the core region of the atoms which occur in quantum Monte Carlo all-electron schemes are avoided. The method is applied to calculate the cohesive energy and structural properties of diamond and the first ionization energy and electron affinity of the carbon atom. Results are in excellent agreement with experiment. 8 refs., 1 fig., 2 tabs.

46995 (N—88-22382, pp vp) **Features and applications of the integrated composites analyzer (ICAN) code.** Ginty, C.A. May 1988. NTIS, PC A14/MF A01. (NASA-CP—3003-VOL-2; E—3970-VOL-2; NAS—1.55:3003-VOL-2; CONF-8805178—).

From Lewis structures technology symposium; Cleveland, OH, USA (24 May 1988).

The thermal behavior of composite spacecraft antenna reflectors was investigated with the Integrated Composites Analyzer (ICAN) computer code. Parametric studies were conducted on the face sheets and honeycomb core which constitute the sandwich-type structures. Selected thermal and mechanical properties of the composite faces and sandwich structures are presented graphically as functions of varying fiber volume ratio, laminate configuration, fabrication factors, and environmental conditions.

46996 **(N—88-22805) Synthesis and characterization of high-T(sub c) screen-printed Y-Ba-Cu-O films on alumina.** Bansal, N.P.; Simons, R.N.; Farrell, D.E. (National Aeronautics and Space Administration, Cleveland, OH (USA). Lewis Research Center). 1988. 11p. (NASA-TM—100860; E—4069; NAS—1.15:100860; CONF-880504—). NTIS, PC A03/MF A01.

From 90. annual meeting of American Ceramic Society; Cincinnati, OH, USA (1 May 1988).

Thick films of $YBa_2Cu_3O_{(7-x)}$ have been deposited on highly polished alumina substrates by the screen printing technique. To optimize the post-printing heat treatment, the films were baked at various temperatures for different lengths of time and oxygen-annealed at a lower temperature. The resulting films were characterized by electrical resistivity measurements, x-ray diffraction, and optical and scanning electron microscopy. Properties of the films were found to be highly sensitive to the post-printing thermal treatment. Films baked for 15 min at 1000 C in oxygen were hard, adherent, near single phase, and superconducting with T(sub c)(onset) approx 96 K, T(sub c)(zero) approx 66 K and Delta T sub c (10 to 90 percent) approx 10 K.

46997 **(PNL/SRP-SA—15171) Planned investigations for packing materials for a waste package in a salt repository: [Final report].** Shade, J.W.; Bunnell, L.R.; Thornton, T.A. (Pacific Northwest Lab., Richland, WA (USA)). Oct 1987. Contract AC06-76RL01830. 22p. (CONF-8709171—2). NTIS, PC A03/MF A01; 1; GPO Dep. Order Number DE88014074/JAW.

From Joint FRG/USA salt near-field geochemistry workshop; Albuquerque, NM, USA (22 Sep 1987).

A considerable number of materials have been either proposed or investigated as packing materials for nuclear waste package systems. Almost always the expandable clays, such as the smectites contained in commercial bentonites, have received the most attention when their primary function is to retard groundwater flow. Other materials including zeolites, metals, and dessicants are considered as special-purpose additives. Materials that tend to hydrolyze and lead to porosity reduction, such as silicates, oxides, and sulfates, have also been suggested as packing materials. All these types of materials are also considered as components of tailored mixtures to achieve a broad range of packing material performance. Some of these materials are reviewed, along with proposed candidate materials, with respect to the properties required to function in a salt repository. The investigation of packing materials is composed of five studies which are discussed below. Initial candidates will consist of calcium hydroxide, a sodium silicate, and a cement-gypsum mixture in addition to the reference crushed salt. Consequently these tests will be necessary to determine properties of individual components and to optimize properties of mixtures. 13 refs., 7 figs., 1 tab.

46998 **(SAND—87-2054C) Microrheological observations of the onset of non-Newtonian behavior in suspensions.** Mondy, L.A.; Graham, A.L.; Gottlieb, M. (Sandia National Labs., Albuquerque, NM (USA); Los Alamos National Lab., NM (USA)). 1988. Contract AC04-76DP00789;W-7405-ENG-36. 5p. (CONF-880827—3; LA-UR—88-582). NTIS, PC A02/MF A01; 1; GPO Dep. Order Number DE88006198/JAW.

From 10. international congress on rheology; Sydney, Australia (14 Aug 1988).

As the column fraction of solids increases above about 0.30, suspensions of non-Brownian, uniform spheres in Newtonian liquids begin to exhibit shear-thinning, normal stresses, and other non-Newtonian behavior. Here, we report on observations obtained from falling-ball and capillary rheometry at these high volume fractions. Specifically, we find that measured viscosity values are dependent on the size-scale of the viscometer (cylinder diameter, D, and falling- ball diameter, d) relative to the diameter of the suspended spheres d/sub s/. We report the dependence of the measured viscosity on the ratios d/d/sub s/, D/d, and D/d/sub s/, as well as critical values of these ratios above which the apparent viscosity is constant. 5 refs., 3 figs., 1 tab.

46999 (SAND—87-2313C) Structure and growth of silica condensation polymers. Keefer, K.D. (Sandia National Labs., Albuquerque, NM (USA)). 1987. Contract AC04-76DP00789. 24p. (CONF-8711207—1). NTIS, PC A03/MF A01; 1; GPO Dep. Order Number DE88012959/JAW.

From American Chemical Society meeting; Honolulu, HI, USA (21 Nov 1987).

Inorganic silicate polymers are prepared by the hydrolysis of silicon alkoxides and subsequent condensation of the resulting silanols. The structures can be described only in a statistical fashion by means of fractal geometry. The structures are controlled by the relative rates of the hydrolysis reactions which generate reactive silanol groups and the condensation reactions of those groups. Under alkaline conditions, hydrolysis tends to be slow with respect to condensation, and non-fractal colloidal structures form by a nucleation and reaction limited growth process. Under acidic condition, hydrolysis tends to be fast with respect to condensation, and "polymeric" fractal structures with D/sub f/ = 2.1 are formed by reaction limited cluster aggregation. The exact structure in real systems may only approach these idealized cases. 20 refs., 4 figs.

47000 (SAND—88-0106C) The effects of tensile stress on the Raman spectrum of silica glass. Tallant, D.R.; Michalske, T.A.; Smith, W.L. (Sandia National Labs., Albuquerque, NM (USA)). 1988. Contract AC04-76DP00789. 8p. (CONF-880726—2). NTIS, PC A02/MF A01; 1; GPO Dep. Order Number DE88012666/JAW.

From 4. international conference on structure of non-crystalline materials; Oxnard, CA, USA (18 Jul 1988).

Uniaxial tension applied to vitreous silica fibers causes their Raman bands at 440 cm/sup {minus}1/, 800 cm/sup {minus}1/, 1050 cm/sup {minus}1/, and 1190 cm/sup {minus}1/ to decrease in frequency. The minimal effect of tensile stress on the frequency of defect bands at 490 cm/sup {minus}1/ and 605 cm/sup {minus}1/ supports their assignment to small ring structures. 10 refs., 2 figs., 1 tab.

47001 (SAND—88-0559C) Effects of anion size and disorder on spin resonance in the BEDT-TTF [bis(ethylenedithio)tetrathiafulvalene] salts. Venturini, E.L.; Schirber, J.E.; Wang, H.H.; Williams, J.M. (Sandia National Labs., Albuquerque, NM (USA); Argonne National Lab., IL (USA)). 1988. Contract AC04-76DP00789;W-31109-ENG-38. 9p. (CONF-880669—8). NTIS, PC A02/MF A01; 1; GPO Dep. Order Number DE88013022/JAW.

From International conference on science and technology of synthetic metals; Santa Fe, NM, USA (26 Jun 1988).

The effect of different linear trihalide anions on electron spin resonance (ESR) spectra have been studied for single crystals of four BEDT-TTF salts plus one crystal containing mixed anions. Structural disorder is reflected in an increased low-temperature (residual) ESR linewidth for both β-(BEDT-TTF)$_2$I$_3$ and β-(BEDT-TTF)$_2$I$_2$Br and for (nominally) β-(BEDT-TTF)$_2$(AuI$_2$)/sub 0.82/(I$_3$)/sub 0.18/. Suppression of the disorder transition in β-(BEDT-TTF)$_2$I$_3$ by application of shear stress to form the β/sup */-phase decreases the residual linewidth while increasing the onset of superconductivity from 1.5 to ~8{degree}K. Anion size (or equivalently unit cell size) has been shown to correlate with the superconducting transition temperature in these isomorphic salts, but we find no correlation between anion size and the ESR spin susceptibility, linewidth or microwave conductivity. 22 refs., 4 figs., 1 tab.

47002 (SAND—88-1784C) Electrically conductive reticulated carbon composites. Sylwester, A.P.; Clough, R.L. (Sandia National Labs., Albuquerque, NM (USA)). 1988. Contract AC04-76DP00789. 8p. (CONF-880669—4). NTIS, PC A02/MF A01; 1; GPO Dep. Order Number DE88012856/JAW.

From International conference on science and technology of synthetic metals; Santa Fe, NM, USA (26 Jun 1988).

This paper reports a new type of electrically conductive composite which offers advantageous properties and controlled processing. These new composites consist of a conductive open-celled, low-density, microcellular, carbonized foam filled with a nonconductive polymer or resin. The open-celled nature of the carbon foam provides a porous three-dimensional reticulated carbon structure. The large continuous-void volume can be readily filled with an insulating polymer or resin resulting in a three-dimensional conductive composite material. 9 refs., 3 figs.

47003 (SAND—88-1796C) Synthesis and properties of BEDSe-TTF. Nigrey, P.J.; Morosin, B.; Duesler, E. (Sandia National Labs., Albuquerque, NM (USA)). 1988. Contract AC04-76DP00789. 7p. (CONF-880669—6). NTIS, PC A02/MF A01; 1; GPO Dep. Order Number DE88013321/JAW.

From International conference on science and technology of synthetic metals; Santa Fe, NM, USA (26 Jun 1988).

We report the synthesis and properties of the π-electron donor molecule 4,5:4',5'-bis(ethylene-1,2-diseleno)-tetrathiafulvalene (BEDSe-TTF) as well as the properties of a novel charge-transfer (C-T) salt derived from it. BEDSe-TTF was obtained in a 25% overall yield by a three-step reaction starting from the organometallic complex, bis(tetrabutylammonium)-bis(2-thione-1,3-dithiole-4,5-diselenolato)nickelate(II). A single crystal x-ray structure determination of BEDSe-TTF showed it to be monoclinic, P2$_1$/n, with a = 6.842(2), b = 14.047(5), c = 16.094(5){angstrom} and β = 94.49(3){degree} having a unit cell volume of 1542{angstrom}^{3} and four molecules per unit cell. Electrochemical oxidation of BDESe-TTF gave single crystals of BEDSe-TTF$^+$ I$_3^-$. The structure of this 1:1 C-T salt was also monoclinic, P2$_1$/n, with a = 12.503, b = 10.592, c = 15.842 {angstrom} and β = 100.12{degree} having a unit cell volume of 2065.4 {angstrom}^{3} and four molecules per unit cell.

47004 (UCID—21338) Investigation of the fire endurance of borated polyethylene shielding material. Foote, K.L. (Lawrence Livermore National Lab., CA (USA)). 17 Jun 1988. Contract W-7405-ENG-48. 18p. NTIS, PC A03/MF A01; 1; GPO Dep. Order Number DE88014693/JAW.

We conducted nine experiments to investigate the fire endurance of a borated polyethylene shielding material to be used in the Engineering Demonstration System. Several chemistry tests were also done. The shielding material was found to melt at 93.5{degree}C, decompose at 230{degree}C, and ignite at 350{degree}C. Five fire tests were done in a realistic configuration and four tests in a pessimistic configuration. The material easily passed all nine tests. In each case, the shielding material never reached ignition temperature and was found acceptable in this proposed application. 7 refs., 10 figs., 3 tabs.

47005 (UCRL—98343) A novel approach to abrasion resistance. Steele, W.A.; Mohr, P.B.; Leider, H.R.; Hirschfeld, T.B. (Lawrence Livermore National Lab., CA (USA)). Mar 1988. Contract W-7405-ENG-48. 12p. (CONF-880885—2). NTIS, PC A03/MF A01; 1; GPO Dep. Order Number DE88014180/JAW.

From IECEC '88; Denver, CO, USA (1 Aug 1988).

The high abrasion and impact loads characteristic of many technologies require frequent maintenance or special materials. Conventional approaches to protection have used either extremely hard coatings or complaint elastomeric coatings. The former are typically ceramic or ceramic-like surfaces produced by direct deposition or by in situ formation by oxidation, carburization or nitriding. Ceramic coatings are very good against abrasion, but are vulnerable to impact damage. Elastomeric coatings have excellent impact resistance and are capable of withstanding deformation; however, they are limited in thermal range and chemical resistance. It is possible to combine the desirable properties of both types by using "hair," a structure in which an extremely hard material can be simultaneously elastic and compliant by virture of a very high L/D ratio. We have demonstrated the good performance of carbon fiber "hair" in resisting damage from impacting particles and have identified a probable failure mechanism. 7 refs., 6 figs., 1 tab.

47006 Production of high-quality amorphous silicon films by evaporative silane surface decomposition. Doyle, J.; Robertson, R.; Lin, G.H.; He, M.Z.; Gallagher, A. (Joint Institute for Laboratory Astrophysics, University of Colorado and National Bureau of Standards, Boulder, Colorado 80309-0440). *Journal of Applied Physics;* **64**: No. 6, 3215-3223(15 Sep 1988).

High-quality hydrogenated amorphous silicon films (a-Si:H) have been produced by decomposition of low-pressure silane gas on a very hot surface with deposition on a nearby, typically 210 °C substrate. A high-temperature tungsten filament provides the surface for heterogeneous thermal decomposition of the low-pressure silane and subsequent evaporation of atomic silicon and hydrogen. These evaporated species (primarily) induce a-Si:H growth on nearby substrates which are temperature controlled using a novel substrate holder. The light and dark conductivities, optical band gap, deposition rates, and light-soaking effects of preliminary films are reported. The decomposition-evaporation process has been examined using a mass spectrometer to directly detect the decomposition rate and the evaporated radical species. Based on this data and other information, a simplified model for the deposition process is suggested. The excellent film quality and the attributes of the deposition process make this technique, which was originally suggested by Wiessman, viable for the fast rate, large-area deposition of a-Si:H for solar cells and other applications.

47007 **Terracing in strained-layer superlattices.** Neumann, D.A.; Zabel, H.; Morkoc, H. (Department of Physics and Materials Research Laboratory, University of Illinois at Urbana-Champaign, Urbana, Illinois 61801). *Journal of Applied Physics;* **64**: No. 6, 3024-3030(15 Sep 1988).

We report on an x-ray diffraction study of GaAs/GaAs/sub 1-//sub x/Sb/sub x/ superlattices grown by molecular-beam epitaxy on miscut GaAs (100) substrates. The fundamental reflections of the superlattice lie on a reciprocal lattice rod which is tilted with respect to the reciprocal lattice rod of the substrate. The satellite reflection, in turn, lies on lines making a constant angle with the reciprocal lattice rod containing the fundamental reflections. This result is attributed to a terraced superlattice which, in addition, is tilted with respect to the substrate. We describe a model which approximates the misfit strain imposed on the superlattice at the interfacial step, and which is capable of relating the average tilt angle to the misfit strain. The same model can also explain the transverse broadenings observed for the superlattice peaks.

47008 **Properties of CdS/ZnCdTe heterojunctions.** Peters, M.G.; Fahrenbruch, A.L.; Bube, R.H. (Department of Materials Science, Stanford University, Stanford, California 94305). *Journal of Applied Physics;* **64**: No. 6, 3106-3111(15 Sep 1988).

A series of CdS/Zn/sub x/Cd/sub 1-//sub x/Te heterojunctions have been prepared by evaporation of CdS onto single-crystal p-type Zn/sub x/Cd/sub 1-//sub x/Te substrates with $x = 0$, 0.1, and 0.3. The junction properties have been evaluated as a function of x, the substrate surface preparation, and the substrate temperature during CdS deposition. The junctions with the best quality correspond to those formed on stoichiometric Zn/sub x/Cd/sub 1-//sub x/Te surfaces. Even with the optimum surface preparation, an increase in x results in an increase in the reverse saturation current and a decrease in the open-circuit voltage. Current versus voltage measurements as a function of temperature indicate that the junction transport can be described by thermally assisted tunneling. Illumination increases the junction transport current, an effect that persists for a measurable time after cessation of illumination. Both results can be described in terms of the effects of interface states, controlling tunneling/recombination and the width of the depletion layer in the Zn/sub x/Cd/sub 1-//sub x/Te.

47009 **Melting of silicon surfaces by high-power pulsed microwave radiation.** James, R.B.; Bolton, P.R.; Alvarez, R.A.; Christie, W.H.; Valiga, R.E. (Sandia National Laboratories, Livermore, California 94550). *Journal of Applied Physics;* **64**: No. 6, 3243-3253(15 Sep 1988).

We have measured the microwave-induced melting and damage to the near-surface region of arsenic-implanted silicon for 1—2 μs pulses at a frequency of 2.856 GHz and an incident pulse power of up to 9 MW. Rectangular samples were irradiated by single-pass TE/sub 10/ traveling wave pulses inside a WR-284 waveguide, and time-resolved in situ and post-irradiation studies were performed to characterize the material modifications induced by the microwave pulses. The test chamber where the specimens were irradiated was either evacuated to a pressure of 10^{-7}—10^{-6} Torr or filled with a 30-psig pressure of Freon-12. Incident, transmitted, and reflected powers were monitored with directional couplers and fast diodes. The results of the time-resolved optical measurements for samples irradiated in vacuum show that melting of the near-surface region occurs for pulse powers exceeding 3 MW, and that the surface melting is accompanied by a large increase in the reflected microwave power. The onset of the enhanced reflectivity is measured at an earlier time as the microwave power is increased, and once the abrupt increase in the reflectivity is observed, it persists throughout the remainder of the pulse. Simultaneous with the onset of surface damage, we observe a large enhancement in the emission of light from the sample. Results are presented for the temporal behavior and spectral components of the fluorescence as a function of the incident microwave power. The gas pressure in the test cell was also monitored, and a large increase in the gas pressure was detected at the same pulse power as the threshold for the sudden increase in the microwave reflectivity.

47010 **Excess stress and the stability of strained heterostructures.** Tsao, J.Y.; Dodson, B.W. (Sandia National Laboratories, Albuquerque, New Mexico 87185). *Applied Physics Letters;* **53**: No. 10, 848-850(5 Sep 1988).

We derive stability criteria for arbitrary strained heterostructures. The criteria are based on evaluating the excess stress as a continuous function of position within a structure for the two well-known Matthews—Blakeslee [J. W. Matthews and A. E. Blakeslee, J. Cryst. Growth 27, 118 (1974)] dislocation mechanisms for strain relief by plastic flow. If the excess stress for either mechanism exceeds zero anywhere within the structure, then the structure is unstable or metastable to strain relief by that mechanism.

47011 **Depth-dependent imaging of dislocations in heteroepitaxial layers.** Radzimski, Z.J.; Jiang, B.L.; Rozgonyi, G.A.; Humphreys, T.P.; Hamaguchi, N.; Bedair, S.M. (Department of Materials Science and Engineering, North Carolina State University, Raleigh, North Carolina 27695-7916). *Journal of Applied Physics;* **64**: No. 5, 2328-2333(1 Sep 1988).

The generation and propagation of dislocations in GaAsP-InGaAs strained-layer superlattices have been studied using x-ray topography and electron-beam-induced current in the scanning electron microscopy. It is shown that three-dimensional information about dislocations in the substrate, as well as in subsequently grown epilayers, can be obtained via a one-to-one correlation of images obtained from these two techniques. Various types of threading and misfit dislocations are identified and their location specified.

47012 **Thermal-wave imaging of voids in structural ceramics.** No, K.; McClelland, J.F. (Center for Nondestructive Evaluation and Ames Laboratory, U.S. Department of Energy, Iowa State University, Ames, Iowa 50011). *Journal of Applied Physics;* **64**: No. 5, 2801-2803(1 Sep 1988).

Laser-excited thermal-wave magnitude and phase images were acquired by photoacoustic detection in the 20- to 1000-Hz modulation frequency range on surface and bulk laser absorbing ceramics having 20- to 50-μm-diam. voids and compared to optical photomicrographs made in reflection and transmission. Thermal-wave images were more straightforward to interpret for the voids in the ceramics which absorb light at the irradiated surface (surface thermal-wave generation) rather than in the bulk (bulk thermal-wave generation) because the bulk generated thermal-wave signal also involved the light reflection at the void interface.

47013 **Porosity for the penetrable-concentric-shell model of two-phase disordered media: Computer simulation results.** Lee, S.B.; Torquato, S. (Department of Mechanical and Aerospace Engineering, North Carolina State University, Raleigh, North Carolina 27695-7910). *Journal of Chemical Physics;* **89**: No. 5, 3258-3263(1 Sep 1988).

Computer-simulation results are reported for the porosity of a model of two-phase random media composed of identical D-dimensional spheres ($D = 2$ or 3) distributed with an arbitrary degree of impenetrability λ, $0 \leq \lambda \leq 1$; $\lambda = 0$ corresponding to randomly centered or "fully penetrable" particles and $\lambda = 1$ corresponding to totally impenetrable particles. We specifically consider the D-dimensional penetrable-concentric-shell model in which each

sphere of diameter σ is composed of a mutually impenetrable core of diameter $\lambda\sigma$, encompassed by a perfectly penetrable concentric shell of thickness $(1-\lambda)\sigma/2$. We develop two independent techniques to sample for the porosity. Simulation results agree with known exact results for the extreme limits of $\lambda = 0$ and $\lambda = 1$ up to three significant figures. The results for intermediate λ are new and compare favorably with approximate analytical expressions obtained by Rikvold and Stell.

47014 **Performance of protective polymeric coatings for nonlinear optical materials.** Marshall, K.L.; Schmid, A.W.; Smith, D.J.; Bevin, A.A.; Guardalben, M.J.; Jacobs, S.D. (Laboratory for Laser Energetics and The New York State Center for Advanced Optical Technology of The Institute of Optics, University of Rochester, 250 East River Road, Rochester, New York 14623-1299). *Journal of Applied Physics;* 64: No. 5, 2279-2285(1 Sep 1988).

KDP, KD*P, and $LiNbO_3$, three nonlinear optical materials that have been difficult to coat, are treated with polymeric surface layers. These layers hermetically seal the hygroscopic crystal surfaces. Their optical properties, thermal compatibility, high-power laser damage behavior, abrasive resistance, and suitability for overcoating with traditional, dielectric antireflection multilayers are reported.

47015 **Equation of state of polymer melts: General formulation of a microscopic integral equation theory.** Schweizer, K.S.; Curro, J.G. (Sandia National Laboratories, Albuquerque, New Mexico 87185). *Journal of Chemical Physics;* 89: No. 5, 3342-3349(1 Sep 1988).

A microscopic statistical mechanical theory for the virial equation of state of polymer liquids is developed by combining reference interaction site model (RISM) integral equation methods for flexible chain molecules with a superposition approximation for three-body orientational correlation functions. A compact expression for the pressure is obtained for athermal (hard core) fluids by neglecting explicit chain end effects. An analytical analysis of three-body contributions to the equation of state is carried out for flexible polymers and the scaling dependence on chain length and monomer density is derived. The merits and disadvantages of the compressibility route to the equation of state are briefly discussed, along with the inclusion of attractive intermolecular forces via thermodynamic perturbation theory.

47016 **Equation of state of polymer melts: Numerical results for athermal freely jointed chain fluids.** Schweizer, K.S.; Curro, J.G. (Sandia National Laboratories, Albuquerque, New Mexico 87185). *Journal of Chemical Physics;* 89: No. 5, 3350-3362(1 Sep 1988).

Our microscopic RISM integral equation theory for the virial equation of state of polymer liquids developed in the preceding paper is numerically implemented for athermal melts composed of freely-jointed chains interacting via hard core site—site potentials. A modified ideal description of the single chain intramolecular correlations is employed which rigorously enforces the nonoverlapping core condition and leads to significant local coil expansion. Comparison of the theoretically computed virial pressure for tangent diatomics and short chains with available Monte Carlo simulation results over a wide range of packing fractions suggests the theory is quite accurate. Significant inconsistencies between the pressure computed via the virial and compressibility routes are found and discussed in light of the known limitations of the RISM method and the importance of self-consistency corrections for flexible chain molecule liquids. A detailed numerical study of the density and degree of polymerization dependences of the total virial pressure, and its individual two- and three-body components, is presented, along with the limiting infinite chain behavior. The integral equation results are also compared with the predictions of several simple mean field and/or lattice models for both short chains and high polymers. Significant, and in some cases massive, differences are found between the predictions of the various approaches and the integral equation calculations which are attributed to the neglect of polymeric connectivity, intermolecular correlations, and/or the use of a lattice model inherent to the simple theories. In particular, both the density dependence of the pressure and its sensitivity to degree of polymerization are found to be much stronger than the simple theories predict due to self-screening and correlation hole effects absent in the latter.

47017 **Temperature dependence of atomic transport in ion mixing.** Hung, L.S.; Xia, W.; Poker, D.B.; Fernandes, M.; Tao, K.; Lau, S.S.; Mayer, J.W. (Department of Materials Science and Engineering, Cornell University, Ithaca, New York 14853). *Journal of Applied Physics;* 64: No. 5, 2354-2358(1 Sep 1988).

The moving species during ion beam mixing of Si/Ni and Si/Pt bilayers were investigated at temperatures between liquid-nitrogen temperature (LN_2) and 180 °C using imbedded markers and Rutherford backscattering. For Si/Ni samples irradiated with Ar ions, the flux ratio of Si to Ni decreased from 1.6 to 0.2 as the substrate temperature increased from LN_2 to 180 °C. Over this range of substrate temperatures, the individual amount of Si atoms transported was found to remain unchanged; whereas the transport flux of Ni atoms was observed to increase. Similar temperature dependence of the flux ratio was found for the Si/Pt system. The experimental results indicate that the substantial Si motion is due to the temperature-independent part of ion mixing which is associated with collision cascades. The Ni motion is characteristic of radiation-enhanced diffusion which is substrate temperature dependent.

47018 **Hydrogen pumping and release by graphite under high-flux plasma bombardment.** Hirooka, Y.; Leung, W.K.; Conn, R.W.; Goebel, D.M.; Labombard, B.; Nygren, R.; Wilson, K.L. (Department of Mechanical, Aerospace and Nuclear Engineering, Institute of Plasma and Fusion Research, University of California, Los Angeles, Los Angeles, California 90024). *Journal of Vacuum Science and Technology, A: Vacuum, Surfaces, and Films;* 6: No. 5, 2965-2977(Sep 1988).

Inert gas (helium or argon) plasma bombardment has been found to increase the surface gas adsorptivity of isotropic graphite (POCO-graphite), which can then getter residual gases in a high-vacuum system. The inert gas plasma bombardment was carried out at a flux $\simeq 1 \times 10^{18}$ ions s^{-1} cm^{-2} to a fluence of the order of 10^{21} ions/cm^2 and at temperatures around 800 °C. The plasma bombarding energy was varied between 100 and 200 eV. The gettering speed of the activated graphite surface is estimated to be as large as 25 l s^{-1} cm^{-2} at total pressures between 10^{-6} and 10^{-7} Torr. The gettering capacity estimated is 0.025 Torr l/cm^2 at room temperature. The gettering capability of graphite can be easily recovered by repeating inert gas plasma bombardment. The activated graphite surface exhibits a smooth, spongelike morphology with significantly increased pore openings, which correlates with the observed increase in the surface gas adsorptivity. The activated graphite surface has been observed to pump hydrogen plasma particles as well. From calibrated H-alpha measurements, the dynamic hydrogen retention capacity is evaluated to be as large as 2×10^{18} H/cm^2 at temperatures below 100 °C and at a plasma bombarding energy of 300 eV. The graphite temperature was varied between 15 and 480 °C.

47019 **Strain-induced lateral confinement of excitons in GaAs-AlGaAs quantum well microstructures.** Kash, K.; Worlock, J.M.; Sturge, M.D.; Grabbe, P.; Harbison, J.P.; Scherer, A.; Lin, P.S.D. (Bell Communications Research, Red Bank, New Jersey 07701). *Applied Physics Letters;* 53: No. 9, 782-784(29 Aug 1988).

We report evidence for lateral confinement of excitons within a continuous two-dimensional GaAs-AlGaAs quantum well. The confinement to "wires" within the well was produced by partially etching a pattern through the upper AlGaAs barrier. We propose a new mechanism, that of patterned strain, for lateral quantum confinement of carriers in semiconductor microstructures, to explain our results.

47020 **K-resolved alloy bowing in pseudobinary In/sub x/Ga/sub 1-//sub x/As alloys.** Hwang, J.; Pianetta, P.; Pao, Y.; Shih, C.K.; Shen, Z.; Lindberg, P.A.P.; Chow, R. (Stanford Synchrotron Radiation Laboratory, Stanford University, Stanford, California 94305). *Physical Review Letters;* 61: No. 7, 877-880(15 Aug 1988).

k-resolved alloy-bowing data for In/sub x/Ga/sub 1-//sub x/As alloys have been taken and used to examine the validity of different alloy formalisms. Although the molecular coherent-potential approximation is considered to be the most complete alloy formalism for zinc-blende pseudobinary alloys, it is not in agreement with the experimental k-resolved data. In contrast, these k-resolved data are in approximate agreement with the coherent-potential-approximation prediction. This implies that the implementation of the bond-length disorder effect in the molecular coherent-potential approximation needs to be modified.

47021 **Local-field effects in Langmuir-Blodgett films of hemicyanine and behenic acid mixtures.** Hayden, L.M. (Department of Physics, University of California, Davis, California 95616). *Physical Review* [*Section*] *B: Condensed Matter;* **38**: No. 6, 3718-3721(15 Aug 1988).

The effective local-field factors for a system of adsorbed molecules are measured in Langmuir-Blodgett films consisting of mixtures of the n-docosyl homologue of hemicyanine dye and behenic acid. The effect of the local-field correction factors on the interpretation of the molecular orientation of the hemicyanine chromophore, as determined by macroscopic measurements of the optical second-harmonic generation from these molecules, is reported, and the measured values of the local-field correction factors are compared with the theory of Ye and Shen. The range of the induced-dipole—induced-dipole interaction of hemicyanine chromophores in Langmuir-Blodgett films is seen to be ~10 A.

47022 **Theory of quasiparticle surface states in semiconductor surfaces.** Hybertsen, M.S.; Louie, S.G. (AT&T Bell Laboratories, Murray Hill, New Jersey 07974). *Physical Review* [*Section*] *B: Condensed Matter;* **38**: No. 6, 4033-4044(15 Aug 1988).

A first-principles theory of the quasiparticle surface-state energies on semiconductor surfaces is developed. The surface properties are calculated using a repeated-slab geometry. Many-body effects due to the electron-electron interaction are represented by the electron self-energy operator including the full surface Green's function and local fields and dynamical screening effects in the Coulomb interaction. Calculated surface-state energies for the prototypical Si(111):As and Ge(111):As surfaces are presented. The calculated energies and dispersions for the occupied surface states (resonances) are in excellent agreement with recent angle-resolved photoemission data. Predictions are made for the position of empty surface states on both surfaces which may be experimentally accessible. The resulting surface state gap at Gamma-bar for Si(111):As agrees with recent scanning-tunneling-spectroscopy measurements. Comparison of the present results to eigenvalues from the local-density-functional calculation reveals substantial corrections for the gaps between empty and occupied surface states. This correction is found to depend on the character of the surface states involved.

47023 **Study of compensation in insulating and metallic n-type CdSe using transport measurements.** Levy, M.; Roy, A.; Sarachik, M.P.; Isaacs, L.L. (Department of Physics, City College of the City University of New York, New York, New York 10031). *Physical Review* [*Section*] *B: Condensed Matter;* **38**: No. 5, 3323-3330(15 Aug 1988).

The resistivity and the Hall coefficient of indium-doped cadmium selenide with carrier concentrations spanning the insulator-to-metal transition have been measured as a function of temperature. We demonstrate that use of the Hall mobility deduced from these data and careful analysis and application of recent theory yield an estimate of the degree of compensation, K = N/sub A//N/sub D/, for metallic as well as insulating material. Combining these results with Hall coefficient measurements at room temperature, one can then estimate both the number of donors, N/sub D/, and acceptors, N/sub A/. .AE

47024 **Raman-scattering and electron-microscopy study of composition-dependent ordering in metastable (A/sup III/B/sup V/)/sub 1-//sub x/(C/sup III/$_2$)/sub x/ alloys.** McGlinn, T.C.; Klein, M.V.; Romano, L.T.; Greene, J.E. (Physics Department and Materials Research Laboratory, University of Illinois at Urbana-Champaign, 104 South Goodwin Avenue, Urbana, Illinois 61801). *Physical Review* [*Section*] *B: Condensed Matter;* **38**: No. 5, 3362-3367(15 Aug 1988).

We present Raman-scattering and electron-diffraction results in a study of the structural ordering of single-crystal metastable (A/sup III/B/sup V/)/sub 1-//sub x/(C_2/sup IV/)/sub x/ alloys. Amorphous-like Raman linewidths are observed, indicative of the severe substitutional disorder in these alloys. Increased violation of the normal zinc-blende-polarization selection rules, relative to that observed in III-V ternary alloys, is attributed to the enhanced electronic disorder in the III-IV-V system. Anomalies in the composition dependence of the Raman line shapes at $x \simeq 0.30$ and $x \simeq 0.70$ imply qualitative changes in the ordering at these compositions. Transmission electron microscopy results are presented which give insight into the nature of these changes. Our results are discussed in the context of competing theoretical models proposed for this system.

47025 **Correlation of scanning-tunneling-microscope image profiles and charge-density-wave amplitudes.** Giambattista, B.; Johnson, A.; McNairy, W.W.; Slough, C.G.; Coleman, R.V. (Department of Physics, University of Virginia, Charlottesville, Virginia 22901). *Physical Review* [*Section*] *B: Condensed Matter;* **38**: No. 5, 3545-3548(15 Aug 1988).

Scanning-tunneling-microscope (STM) studies of 4Hb-TaS_2 and 4Hb-$TaSe_2$ at 4.2 K show systematic correlation between the charge-density-wave (CDW) amplitude and the STM deflection. The 4Hb phases have both weak and strong CDW's in the trigonal prismatic and octahedral sandwiches, respectively. Scans on opposite faces of the same cleave allow a comparison of the STM response to the two types of CDW.

47026 **Monte Carlo study of ^{4}He in two dimensions.** Whitlock, P.A.; Chester, G.V.; Kalos, M.H. (Courant Institute of Mathematical Sciences, New York University, 251 Mercer Street, New York, New York 10012). *Physical Review* [*Section*] *B: Condensed Matter;* **38**: No. 4, 2418-2425(1 Aug 1988).

The Green's function Monte Carlo and variational methods have been used to calculate the properties of the ground state of two-dimensional liquid and solid ^{4}He described by the HFDHE2 potential. The equation of state, melting freezing transition, radial distribution functions in the liquid and solid, and the momentum distribution in the liquid are all presented. Comparisons are made with three-dimensional ^{4}He and two-dimensional classical systems.

47027 **Irradiation facilities at the Idaho National Engineering Laboratory.** Gupta, V.P.; Herring, J.S.; Korenke, R.E.; Harker, Y.D. (Idaho National Engineering Lab., EG and G Idaho, Inc., P.O. Box 1625, Idaho Falls, ID (US)). pp 705-717 of Influence of radiation on material properties: ASTM 13th international symposium (Part II). Garner, F.A.; Henager, C.H.; Igata, N. Philadelphia, PA; ASTM (1987). (CONF-860605—).

From 13. international symposium on the effects of radiation on materials; Seattle, WA, USA (23 Jun 1986).

Although there is a growing need for neutron and gamma irradiations by governmental and industrial organizations in the United States and in other countries the number of facilities providing such irradiations are limited. At the Idaho National Engineering Laboratory, there are several unique irradiation facilities producing high neutron and gamma radiation environments. These facilities could be readily used for nuclear research, materials testing, radiation hardening studies on electronic components/circuitry and sensors, and production of neutron transmutation doped (NTD) silicon and special radioisotopes. In addition, a neutron radiography unit, suitable for examining irradiated materials and assemblies, is also available. This paper provides a description of the irradiation facili-

ties and the neutron radiography unit as well as examples of their unique applications.

47028 **Damage resistance and crystal growth of KDP.** Cooper, J.F.; Singleton, M.F. (Lawrence Livermore National Lab., Univ. of California, P.O. Box 5508, L-490, Livermore, CA (US)). pp 6-9 of Laser and nonlinear optical materials. De Shazer, L.G. Bellingham, WA; SPIE Society of Photo-Optical Instrumentation Engineers (1986). (CONF-860880—).

From 30. SPIE technical symposium on optics and optoelectronic engineering; San Diego, CA, USA (17 Aug 1986).

An investigation is reported of the dependence of laser-damage site density on fluence and on various parameters of crystal growth and post-growth treatment. Damage site density (number of defects per unit volume) was found to increase monotonically with fluence (for single 1-ns pulses of 1.06 μm laser light). Site density (at a fluence of 10 J/cm/sup 2/) was influenced by solution flow rate, seed defect removal prior to growth, quaternary ammonium cations, and thermal cycling following growth. No dependence of damage susceptibility on growth rate was found over the range 3-30 mm/d. A model is presented which postulates the electrostatic adsorption of organic material onto the growing crystal surface and subsequent inclusion into the crystal. According to the model, damage occurs by absorption of light by inclusions of solution-wetted organic debris, resulting in pressure increase and hydraulic fracture of the surrounding crystal.

47029 **Quantum mechanics and fracture.** Eberhart, M.E. (Materials Science and Technology Div., Los Alamos National Lab., Los Alamos, NM (US)). pp 71-109 of Advances in the mechanics and physics of surfaces - Volume 3 - 1986. Latanision, R.M.; Fischer, T.E. New York, NY; Harwood Academic Pub. (1986).

The mechanisms of fracture are increasingly being investigated with the aid of quantum mechanical calculations. This paper investigates the method, content and meaning of such calculations in an attempt to place the role of electronic structure theory, as a tool for the study of fracture, in the proper perspective.

47030 **A review of combined impurity segregation - Hydrogen embrittlement processes.** Jones, R.H. (Pacific Northwest Lab., Richland, WA (US)). pp 1-60 of Advances in the mechanics and physics of surfaces - Volume 3 - 1986. Latanision, R.M.; Fischer, T.E. New York, NY; Harwood Academic Pub. (1986).

There is now clear evidence that the fracture properties of materials degraded by either impurity segregation or hydrogen can be further degraded by their simultaneous presence. However, the available data suggest that there is a limit to the extent of the combined embrittlement and that in the regime where combined embrittlement processes occur, the effects of impurities and hydrogen are additive. A clear understanding of the mechanisms of combined embrittlement has not emerged , probably due in part to the lack of a clear understanding of hydrogen embrittlement. A better understanding of the chemical interactions between impurities and hydrogen in and near grain boundaries of materials is needed to further the development of models of impurity-hydrogen embrittlement.

47031 **Growth of (110) GaAs/GaAs by molecular beam epitaxy.** Parechanian, L.T.; Weber, E.R.; Hierl, T.L. (Univ. of California at Berkeley, Dept. of Materials Science and Center for Advanced Materials (Lawrence Berkeley Labs.), Berkeley, CA (US)). pp 391-396 of Microscopic identification of electronic defects in semiconductors. Johnson, N.M.; Bishop, S.G.; Watkins, G.D. Pittsburgh, PA; Materials Research Society (1985). (CONF-850421—).

From 2. spring meeting of the Materials Research Society; San Francisco, CA, USA (15 Apr 1985).

The simultaneous molecular beam epitaxy (MBE) growth of (100) and (110) GaAs/GaAs intentionally doped with Si(—1E16/cmA3) was studied as a function of substrate temperature, arsenic overpressure, and epitaxial growth rate. The films were analyzed by scanning electron and optical microscopy, liquid helium photoluminescence (PL), and electronic characterization. For the (110) epitaxal layers, an increase in morphological defect density and degradation of PL signal was observed with a lowering of the substrate temperature from 570C. Capacitance-voltage (CV) and Hall Effect measurements yield room temperature donor concentrations for the (100) films of n—7E15/cmA3 while the (110) layers exhibit electron concentrations of n—2E17/cmA3. Hall measurements at 77K on the (100) films show that expected mobility enhancement of Si donors, whereas the (110) epi layers become insulating or greatly compensated. This behavior suggests that room temperature conduction in the (110) films is due to a deeper donor partially compensated by an acceptor level whose concentration is of the same order of magnitude as that of any electrically active Si. Temperature dependent Hall effect indicates that the activation energy of the deeper donor level lies —290 meV from the conduction band. PL and Hall effect indicate that the better quality (110) material is grown by increasing the arsenic flux during MBE growth. The nature of the defects involved with the growth process is discussed.

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47032 **(ASNT/CN—6) IAEA regional training course use of nuclear techniques in health-related environmental research and monitoring: 28 April-30 May 1986, Sydney/Darwin. Proceedings.** Fardy, J.J.; Parr, R.M.; Toner, B. (Australian School of Nuclear Technology, Lucas Heights). 1987. 733p. NTIS (US Sales Only), PC A99/MF A01. Order Number DE88702837/JAW.

Hosted by the Australian Atomic Energy Commission in cooperation with the IAEA. 2 volumes.

The proceedings cover the use of nuclear techniques to show what measurements can be made in order to detect changes in environmental patterns. Nuclear techniques used for detecting and measuring a wide variety of pollutants which cause harmful effects on mankind and the environment are reported.

47033 **(CONF-880732—1) Photoacoustic spectroscopy and the in situ characterization of the electrochemical interface.** Vallet, C.E. (Oak Ridge National Lab., TN (USA)). 1988. Contract AC05-84OR21400. 26p. NTIS, PC A03/MF A01; 1; GPO Dep. Order Number DE88013848/JAW.

From Spectroscopic and diffraction techniques in interfacial electrochemistry; Puerto de la Cruz, Spain (3 Jul 1988).

Photoacoustics is a new spectroscopic method which has been used for in situ characterization of the electrochemical interface during the past ten years. The basic principles of the photoacoustic effect and the principal results of the Rosencwaig-Gersho theory are discussed in light of the usefulness of the method in electrochemical studies. Different experimental arrangements suitable for in situ electrode studies are presented. A review of the use to date of photoacoustics in electrochemistry includes studies of electrochromic systems, semiconductor electrodes, passivation layers, and of electrocatalytic mixed oxides. These works demonstrated that, with relatively simple apparatus, it was possible to detect and to characterize very thin layers formed on electrodes. It is still not clear whether in most cases photoacoustic spectroscopy has an overwhelming advantage over well-established optical methods for adsorption measurements; however, all the potentialities of the method have yet to be explored. 73 refs., 6 figs.

47034 **(CONF-880841—6) The characterization of amorphous Al_2O_3 by Extended Energy Loss Fine Structure (EXELFS) analysis.** Sklad, P.S.; Angelini, P.; Sevely, J. (Oak Ridge National Lab., TN (USA)). 1988. Contract AC05-84OR21400. 3p. NTIS, PC A02/MF A01; 1; GPO Dep. Order Number DE88007484/JAW.

From MAS/EMSA microbeam analysis conference; Milwaukee, WI, USA (7 Aug 1988).

Recently an investigation of the effects of ion implantation on the microstructure and properties of Al_2O_3 has revealed differences in the response of various forms of amorphous Al_2O_3 to post-

implantation annealing. Specifically the amorphous implanted layer in a specimen implanted with a stoichiometric ratio of aluminum and oxygen at -185{degree}C (Al_2O_3-Al,O) recrystallized into a dual phase microstructure consisting of γ-Al_2O_3 and α-Al_2O_3. In contrast the amorphous layer in a specimen implanted with iron at -185{degree}C (Al_2O_3-Fe) recrystallized completely to epitaxial α-Al_2O_3. In order to understand these differences EXELFS analysis has been performed on several types of Al_2O_3 including Al_2O_3-Al,O and Al_2O_3-Fe, as well as single crystal α-Al_2O_3 and crystalline γ-Al_2O_3. Disko, Bourdillon, and Sevely have also reported EXELFS studies of Al_2O_3. All measurements were made on backthinned specimens prepared using established procedures. Comparison of the results revealed several differences. The Al-O interatomic distances measured in the two forms of amorphous Al_2O_3 differed by {approximately}0.01 nm., regardless of which edge was used for the analysis. Moreover the value measured for Al_2O_3-Al,O agrees with the value measured for crystalline γ-Al_2O_3, the form into which it recrystallizes. In a similar way the Al-O distance measured in the amorphous Al_2O_3-Fe agrees with the value measured for crystalline α-Al_2O_3, the form into which it recrystallizes. Investigation of the relationship between these underlying structural differences and recrystallization behavior is continuing. 7 refs., 3 figs.

47035 (DGMK—305) Determination of carbon, hydrogen, and nitrogen in selected oil and coal samples. Schuchardt, K.; Ewers, H.; Altmann, B.R. (Deutsche Wissenschaftliche Gesellschaft fuer Erdoel, Erdgas und Kohle e.V., Hamburg (Germany, F.R.)). Jul 1987. 257p. (In German). Deutsche Wissenschaftliche Gesellschaft fuer Erdoel, Erdgas und Kohle e.V., Hamburg (Germany, F.R.).

The efficiency of automated measurement techniques to determine the elements carbon, hydrogen and nitrogen was investigated. Calibration substances and technical samples (petroleum products, coals, cokes, coal oils, methanol, methyltertiarbutylether (MTBE)] were selected for testing. 13 laboratories participated in the extensive test programme which comprised about 5500 determinations. (orig.) With 287 figs., 49 tabs., 93 refs.

47036 (DOE/ER/13589—2) The use of ion chromatography-D.C. plasma atomic emission spectrometry for the speciation of trace metals: Annual performance report, August 1, 1986--August 1, 1988. Urasa, I.T. (Hampton Univ., VA (USA). Dept. of Chemistry). 1 Aug 1988. Contract FG05-86ER13589. 30p. NTIS, PC A03/MF A01; 1; GPO Dep. Order Number DE88014728/JAW.

An Ion Chromatograph (IC) was used in combination with a DC. Plasma Atomic Emission Spectrometer (DCPAES) to study the chemistry of and to speciate seven metals in aqueous solutions. The element selective nature of DCPAES allowed the direct detection of all forms of a targeted element with equal efficiency. The aqueous chemistry of metals such as Cr, Mn, Pt, and V was quite different from theoretical expectations, and was greatly influenced by the acidity of the solution. In some cases, a transformation occurred as acidity changed. In others, eg. with Pt, more than one charged moieties were formed in aqueous solution. With IC-DCPAES, these transformations and the appearance of different moieties can be monitored and quantitated. The approach was applied in trace metal analysis of natural water and waste water samples. The measurable concentrations of the metal ions studied were in the low ppM range. Detection of ppB concentrations is desired. The measures employed to improve measurement sensitivity assumed the availability of a large sample volume. A scheme for interfacing the IC to the DCPAES to ensure the introduction of 90--100% of the chromatographic effluent into the DCPAES and hence facilitating the detection of ppB concentrations is needed. 14 figs., 2 tabs.

47037 (DP-MS—86-90) High-speed ion-exchange separations prior to neptunium, plutonium, and impurity assays. Maxwell, S.L. III; Forrest, M.H. (Du Pont de Nemours (E.I.) and Co., Aiken, SC (USA). Savannah River Plant). 1986. Contract AC09-76SR00001. 7p. (CONF-860944—6). NTIS, PC A02/MF A01; 1; GPO Dep. Order Number DE88014299/JAW.

From 29. conference on analytical chemistry in energy technology; Knoxville, TN, USA (29 Sep 1986).

Separation of actinides and/or impurities prior to assay is required when sample matrix components interfere with the assay method. Separations frequently must be performed in glove boxes or shielded and analytical cells due to high levels of alpha/beta-gamma radioactivity. Conventional ion-exchange separations are typically more effective and quantitative than solvent extraction, but are prohibitively slow for routine application. At the Savannah River Plant, effective ion-exchange purifications of process samples are now performed with a modified commercial vacuum extraction system. The combination of relatively small-size ion-exchange resin particles and applied vacuum provides rapid, efficient, quantitative separations. High-speed ion exchange has been successfully applied at SRP to the separation of neptunium from plutonium and to the separation of trace impurities from uranium product solutions prior to neptunium and impurity assays by direct current argon plasma (DCAP) emission spectrometry. This paper will describe several separations and will present details of developed procedures and subsequent assays.

47038 (IEN-DIAPQ—3/85) Radiocrystalographic study on chernovite from Jaguaracu, Minas Gerais State, Brazil. Baptista, N.R.; Baptista, A. (Instituto de Engenharia Nuclear, Rio de Janeiro (Brazil)). 1985. 9p. (In Portuguese). NTIS (US Sales Only), PC A02/MF A01. Order Number DE88703860/JAW.

Some data on study of chernovite crystals, YAsO/sub 4/ localized in Jaguaracu state of Minas Gerais, Brazil are reported. The spectrochemical analysis and methods used for identification, as well as its chemical composition are described. (M.J.C.).

47039 (IEN-DIAPQ—09/87) Fluorimetric analysis of gallium in bauxite, by-products, products from gallium processing and its control solutions. Ferreira, C.A.M.; Medeiros, V. (Instituto de Engenharia Nuclear, Rio de Janeiro (Brazil)). 1987. 10p. (In Portuguese). NTIS (US Sales Only), PC A02/MF A01. Order Number DE88703861/JAW.

The gallium processing since raw material analysis until end-products analysis is studied. Gallium presence in by-products and products, as well as the fluorimetric method is analyzed. Equipments and materials used in laboratory, reagents and chemical solutions are described. (M.J.C.).

47040 (INIS-BR—1164, pp 34) Study of micelles in solution in the dodecyl (Lauril) sodium sulfates (SLS) system in water by small-angle X-Ray scattering (SAXS). Itri, R.; Amaral, L.Q. do. (Sao Paulo Univ. (Brazil). Inst. de Fisica). 1987. (In Portuguese). NTIS (US Sales Only), PC A09/MF A01. Order Number DE88703566/JAW. (CONF-8705181—).

From 10. national meeting on condensed matter physics; Caxambu, Brazil (5 May 1987).

47041 (INIS-BR—1179) Study of the emission oxidative reactions of ruthenium (II) complex by cationic compounds in anionic micelles. Bonilha, J.B.S. (Faculdade de Filosofia, Ciencias e Letras de Ribeirao Preto (Brazil)). 1985. 157p. (In Portuguese). NTIS (US Sales Only), PC A08/MF A01. Order Number DE88703872/JAW.

The oxidative quenching of the emission of the tetraanionic complex tris (4,4' dicarboxylate - 2,2' - bipyridine ruthenium (II) in aqueous solution, by both organic and inorganic compounds in presence of anionic detergents, above and below the critical micelle concentration is studied. The organic cations, the inorganic ion and detergents used are shown. (M.J.C.).

47042 (INIS-BR—1183) Study of some properties of the ruthenium (II) trans-tetra-ammines with nitrogened aromatic heterocyclic ligands. Bento, M.L. (UNESP, Araraquara (Brazil). Inst. de Quimica). 1985. 115p. (In Portuguese). NTIS (US Sales Only), PC A06/MF A01. Order Number DE88703876/JAW.

The ruthenium (II) complexes trans [Ru(NH/sub 3/)/sub 4/ LL'] (BF/sub 4/)/sub 2/, where L and L' are 4-picoline, pyridine, isonicatinamide, pyrazine or 4-acetylpyridine are studied. The U.V-visible range spectra, bands in the U.V. and in the visible range is

analysed. The spectra and the bands by comparison with other ruthenium (II) ammines are discussed, and a qualitative molecular orbital model is used. (M.J.C.).

47043 **(INIS-BR—1184) Selenium determination by fluorimetric method.** Lavorenti, A. (Sao Paulo Univ., Piracicaba (Brazil). Escola Superior de Agricultura Luiz de Queiroz). 1981. 95p. (In Portuguese). NTIS (US Sales Only), PC A05/MF A01. Order Number DE88703877/JAW.

A fluorimetric method to determine selenium both in vegetable samples and blood serum is developed. The method consists of a radioisotope /sup 75/Se initially in order to optimize the determination of analytical conditions. Three samples digestion processes and also some factors related to methodology is studied. The nitric-percloric digestion process for 40 samples and the analytical process is shown. (M.J.C.).

47044 **(INIS-BR—1185) Polimerization of methyl metacrylate in Schizolobium Parahyba (Vell.) Blake (Guapuruvu) and Pinus strobus VAR. Chiapensis mart. wood through Gamma radiation and temperature.** Carneiro, M.G. (Sao Paulo Univ., Piracicaba (Brazil). Escola Superior de Agricultura Luiz de Queiroz). 1982. 100p. (In Portuguese). NTIS (US Sales Only), PC A05/MF A01. Order Number DE88703878/JAW.

Guapuruvu (Schizolobium parahyba) wood samples that were impregnated with the methyl metacrylate monomer and polymerized by the use of gamma rays from a $6$0Co source at different dose exposure and total dose is analysed. The impregnation process by vacuum-atmospheric pressure its densities and the storage of the impregnated wood samples with monomer is described. The thermic process and the amount of absorved water, and the density values obtained through attenuation of gamma radiation are analyzed. (M.J.C.).

47045 **(INIS-BR—1188) On addition compounds between lanthanide perhenates and N, N, N', N' - tetramethylurea.** Santana Nunes, D.J. de. (Sao Paulo Univ. (Brazil). Inst. de Quimica). 1973. 65p. (In Portuguese). NTIS (US Sales Only), PC A04/MF A01. Order Number DE88703881/JAW.

The addition compounds of lanthanide perhenates and tetramethylurea (TMU) is described. The products were characterized by infra-red spectra, mohar conductance in methanol and X-ray diffraction powder patterns. According to the X-ray patterns three groups of compounds are studied. (M.J.C.).

47046 **(INIS-BR—1189) New methods of synthesis for zirconium (IV) complexes: Synthesis and characterization of zirconium (IV) complexes with N, N' - ethylenebis (salicylideneimine) and 8 - hidroxiquinaline.** Fernandes, J.D.G. (Bahia Univ., Salvador (Brazil). Inst. de Quimica). 1980. 56p. (In Portuguese). NTIS (US Sales Only), PC A04/MF A01. Order Number DE88703882/JAW.

New compounds of zirconium (IV) with 8-hidroxiquinoline and N, N' - ethylenebis (salicylideneimine) as ligands are described. The compounds with oxine presented the formulas Zr (Ox)/sub 4/ and Zr (Ox)/sub 4/. C/sub 6/ H/sub 6/, depending on the starting material used ZrOcl/sub 2/. 8H/sub 2/O or Zr (acac)/sub 4/. The compounds with salen H/sub 2/ presented formulas which depend on the heating time and the molar ratio of the reagents. The compounds are crystalline and light-yellow. The products were characterized by elemental analysis of zirconium and/or carbon, hidrogen and nitrogen. According to the analytical data, the infrared spectra and theoretical considerations, we suggested the formulas of compounds. The compounds with oxine were recrystallized in totuol and the crystais can be used in a future X-ray study.

47047 **(INIS-BR—1208) Studies on the interaction of benzotriazole (a corrosion inibitor) with the ruthenium (II) (III) ammincomplexes and pentacyanoferrate (II).** Espinoza R, R.L. (Pontificia Univ. Catolica do Rio de Janeiro (Brazil). Dept. de Quimica). 1985. 220p. (In Portuguese). NTIS (US Sales Only), PC A10/MF A01. Order Number DE88703899/JAW.

Some studies on the interaction of benzotriazole with the aquapentacyanoferrate (II), aquapentaamminruthenium (II) and cis- and trans-(NH/sub 3/)/sub 4/ Ru(H/sub 2/O)/sub 2//sup 2+/ complexes are described. The reactions, substituted products and complexes production are demonstrated. The absorption bands for the ammine (benzotriazole) and ruthenium (II) complexes as well as the activation parameters and kinetics of reactions are discussed. (M.J.C.).

47048 **(INIS-mf—11790) Separation and measurement of very small amounts of /sup 99g/Tc.** Herrmann, G.; Trautmann, N. and others. (Mainz Univ. (Germany, F.R.). Inst. fuer Kernchemie; Bundesministerium fuer Forschung und Technologie, Bonn (Germany, F.R.)). [1987]. 10p. (In German). NTIS (US Sales Only), PC A02/MF A01. Order Number DE88754597/JAW.

Owing to metrological and chemical problems, it has been impossible until now to make clear statements on the radioecological importance of /sup 99g/Tc, a pure β/sup -/ emitter with a half-life of 2.14x10/sup 5/ years and a 6% yield in /sup 235/U fission. High-efficiency /sup 99g/Tc separation processes are therefore required. The authors developed a separation process in which Tc was extracted in tetraphenyl arsenium chloride and measured directly in a liquid scintillation counter after re-extraction and one more extraction in tri-n-butylphosphate. Another separation process aimed at separating Tc from reprocessed uranium. Liquid scintillation spectrometry, anticoincidence counter measurement, neutron activation analysis and laser resonance ionisation mass spectrometry were investigated in terms of their detection limits and experimental expenditure. The highest sensitivity was found for laser resonance ionisation mass spectrometry.

47049 **(IYF-R—2-269) Analytical feasibilities of gamma activation determination of gold using heavy-current betatron.** Babadzhanov, R.D.; Palvanov, S.R.; Ngo Nam Chinh; Aripov, G.; Tadzhibaev, G.Yu. (AN Uzbekskoj SSR, Tashkent. Inst. Yadernoj Fiziki). 1987. 8p. (In Russian). NTIS (US Sales Only), PC A02/MF A01. Order Number DE88703632/JAW.

The analytical possibilites of the gamma-activation method for gold determination using the heavy-current SB-50 betatron at the peak energy of the bremsstrahlung radiation E/sub γm/=18 MeV are investigated. The method is founded on photonuclear reations (γ, γ'), (γ, 2n) on /sup 197/Au. The method of the gold determination in samples of the industrial wastes of electronic engineering is developed. The real limit of the gold determination in these samples is equal to 1.2x10/sup -3/ g/g, 2.5x10/sup -5/ g/g and 8x10/sup -3/ g/g correspondingly, for reactions of the (γ, γ'), (γ, n) and (γ, 2n) types. 5 refs.; 2 figs.; 3 tabs.

47050 **(IYF-R—3-274) Determination of concentration of six elements in certain plants by radioactivation method using a cyclotron.** Mukhamedov, S.M.; Tillaeva, Kh. (AN Uzbekskoj SSR, Tashkent. Inst. Yadernoj Fiziki). 1987. 9p. (In Russian). NTIS (US Sales Only), PC A02/MF A01. Order Number DE88703635/JAW.

The content of Ca, Ti, Fe, Sr, Zn, Cu in some medicinal plants was determined by proton-, deuteron activation analysis via (p, n), (d, 2n) nuclear reactions. The limits of detection is 500 ppm for Ca, 3-10 for Cu, Fe, Zn, Sr, and 0.3 ppm for Ti. 8 refs.; 1 fig.; 3 tabs.

47051 **(IYF-R—3-275) Spectrometric study of natural radionuclide trace amounts in plants.** Mukhamedov, S.M.; Tillaeva, Kh.; Badalov, N.B.; Omonov, Sh. (AN Uzbekskoj SSR, Tashkent. Inst. Yadernoj Fiziki). 1987. 9p. (In Russian). NTIS (US Sales Only), PC A02/MF A01. Order Number DE88703636/JAW.

Small quantities of natural radionuclides have been investigated by γ-spectrometry in some wild plants of Usbekistan, in which /sup 40/k, /sup 214/Bi, /sup 212/Bi, /sup 214/Pb, /sup 212/Pb, /sup 203/Te, /sup 228/Ac are discovered. 4 refs.; 1 fig.; 2 tabs.

47052 **(IYF-R—5-264) Combination of hardware and software for automatic γ-spectra processing in multi-element analysis of ore samples of large mass.** Kist, A.A.; Miranskij, I.A.; Pulatov, D.D.; Bakhrieva, F.B.; Vakher, M.S.; Morozov, A.G.; Lykov, A.S.; Tursunbaev, S. (AN Uzbekskoj SSR, Tashkent. Inst. Yadernoj Fiziki). 1986. 11p. (In Russian). NTIS (US Sales Only), PC A03/MF A01. Order Number DE88703639/JAW.

A complex of hardware and software accomplishing the automatic spectra processing multielement neutron activation analysis of large mass ore sample is described. The set up of the system is accomplished by introducing the standard spectrum and the constants in dialogue mode of operation, after which there occures the changing of samples, the taking off the spectra, the specrum transmission to the computer and their following treatment. The contents of 12 elements in Au-determination mode are calculated. 3 refs.; 4 figs.; 1 tab.

47053 **(LBL—25090) Spectroscopic studies of the passive film on alkali and alkaline earth metals in non-aqueous solvents: A surface science approach, Final report.** Herrera-Fierro, P.; Xing, X.; Chottiner, G.; Scherson, D.A. (Lawrence Berkeley Lab., CA (USA); Case Western Reserve Univ., Cleveland, OH (USA)). Apr 1988. Contract AC03-76SF00098. 34p. NTIS, PC A03/MF A01; 1; GPO Dep. Order Number DE88014048/JAW.

Most of the effort during this year was focused on two areas: the acquisition of detailed information regarding the adsorption of O_2, CO and CO_2 on K covered Ag(111) surfaces, and a cyclic voltammetric study of Ag(111) and Au(111) in tetraalkyl ammonium perchlorate- and $LiClO_4$-propylene carbonate solutions. This report summarizes the progresses made in each of these areas as well as the present status of the instrumental array involved in the ultra high vacuum(uhv)-electrochemical cell experiments. 27 refs., 18 figs., 1 tab.

47054 **(ORNL/M—570) Analytical Chemistry Division annual information meeting: Program abstracts.** Shults, W.D. (Oak Ridge National Lab., TN (USA)). 1988. Contract AC05-84OR21400. 26p. (CONF-880783—Absts.). NTIS, PC A03/MF A01; 1; GPO Dep. Order Number DE88012919/JAW.

From Annual Analytical Chemistry Division information meeting; Oak Ridge, TN, USA (18 Jul 1988).

Fifteen abstracts are included, covering a variety of topics in analytical chemistry. One relates to the neutron dose from the Hiroshima bomb. (DLC)

47055 (PNL-SA—15217, pp 11-26) **Supercritical fluid methods for the analysis of complex fuel and environmental samples.** Smith, R.D.; Yonker, C.R.; Kalinoski, H.T.; Chess, E.K.; Udseth, H.R.; Wright, B.W. 1987. NTIS, PC A99/MF A01. Order Number DE88007332/JAW. (CONF-851027—).

From 24. Hanford life sciences symposium and environmental research on complex organic mixtures; Richland, WA, USA (20 Oct 1985).

The application of supercritical fluid methods can greatly improve the analysis of complex mixtures spanning wide chemical classes. In separations from complex matrices, supercritical fluids can be used to improve extraction efficiency and speed. The variable solvating powers and gas-like diffusion coefficients and viscosities enhance sample enrichment, cleanup and fractionation. Supercritical fluid chromatography (SFC) is applicable to both thermally labile and less volatile materials. Use of small diameter (25- to 50-μm) fused silica capillary columns provides chromatographic efficiencies for SFC which are nearly comparable to conventional capillary gas chromatography and much greater than practical by liquid chromatography (LC). Development of practical capillary SFC/mass spectrometry (MS) instrumentation, allowing both electron impact and chemical ionization MS, is expected to provide a powerful alternative to LC/MS for complex mixture analysis. This paper describes the development of methods to analyze fuels, labile pollutants, hazardous solid waste materials, and related complex environmental mixtures. Application of various supercritical fluids for sample extraction, SFC and SFC/MS, and the recent development of a system for automated supercritical fluid extraction-chromatography are discussed. The potential role of supercritical methods for routine chemical analysis is also evaluated.

47056 (PNL-SA—15217, pp 27-47) **Selective detection of primary aromatic amines in complex mixtures by liquid chromatography with electrochemical detection using a short reversed-phase column.** Otagawa, T.; Zaromb, S.; Stetter, J.R. (Argonne National Lab., IL (USA)). 1987. NTIS, PC A99/MF A01. Order Number DE88007332/JAW. (CONF-851027—). Contract W-31-109-ENG-38.

From 24. Hanford life sciences symposium and environmental research on complex organic mixtures; Richland, WA, USA (20 Oct 1985).

The authors investigated the feasibility of selectively detecting primary aromatic amines (PAA) in the presence of phenols and other interferences by liquid chromatography with electrochemical detection using a short (3-cm), low-back-pressure, reverse-phase column. Separation of PAA from other aromatic compounds was studied at various electrode potentials, and flow rates, using three mobile phases. The phases used a combination of pH and organic modifiers (tetrahydrofuran, acetonitrile, or n-propanol) to optimize the degree of separation. As the pH of the mobile phase was increased, the signals for 2- and 3-ring PAA decreased and became independent of pH at pH values between 4 and 8, while the signals from aniline and phenols increased. Selective detection of PAA is feasible at pH 2.2 at potentials of 0.7 to 0.85 V versus Ag/AgCl. The best result was obtained with a 35 volume-% tetrahydrofuran/water mobile phase, which yielded the highest signal for aniline and the lowest signal for phenol at pH 2.2, with satisfactory retention times. The net signals and retention times approached limiting values at flow rates above 0.4 ml/min. The column efficiency reached a maximum at a flow rate of 0.6 ml/min, which occurred at a back pressure of ~ 100 psi. The electrochemical detectors the authors used were about one thousand times more sensitive to PAA and phenols than ultraviolet detectors. Results obtained will permit design and construction of a portable PAA monitor with an appropriate sample concentrator, pump, and injection system.

47057 **Packed column supercritical fluid chromatography using deactivated stationary phases.** Ashraf-Khorassani, M.; Taylor, L.T.; Henry, R.A. (Virginia Polytechnic Institute and State Univ., Blacksburg (USA)). *Analytical Chemistry;* 60: No. 15, 1529-1533(1 Aug 1988). Contract FG22-81PC40799.

A new cross-linked cyanopropyl bonded phase silica (Deltabond) has been studied as a stationary phase for packed column supercritical fluid chromatography of basic nitrogen-containing compounds. The bonded phase impedes access to uncapped silanol sites, thereby giving rise to better peak shapes and more rapid elution without the necessity of a polar modifier in the mobile phase. Experiments both at elevated temperature and in the presence of a methanol modifier revealed that there is no short- or long-term deleterious effect on the column as opposed to the conventional cyanopropyl phase.

47058 **Precision recording of near-edge profiles of x-ray absorption edges: an improved x-ray spectroscopy.** Chiu, N.S.; Bauer, S.H. (Cornell Univ., Ithaca NY (USA)). *Analytical Chemistry;* 60: No. 15, 1562-1565(1 Aug 1988). Contract FG22-86PC90520.

The intense, highly monochromatized X-ray beams available at the Cornell High Energy Synchroton Source facility permit one to plot the fine structure at absorption edges of elements with atomic number $Z > 18$. With the simple device described in this report, the authors have recorded distinctive features in absorption profiles, with a reproducibility better than +/- 50 meV for the major jumps, when measured with reference to a selected material, generally the metal. These spectra, which reflect locations of the upper states into which the photoelectrons are propelled, can be obtained without pretreatment of the sample (other than grinding to a fine powder) under ambient atmospheric conditions. Of course, spectra at low or high temperatures, under controlled atmospheres, can also be recorded with a more elaborative device. This technique complements information derived from electron energy loss spectroscopy and provides a fingerprint of modifications in the

electronic structure of the element induced by the coordinating shell of surrounding atoms. It is a discriminating analytical probe for characterizing compositional changes in the first coordination shell around the selected atomic centers, due to processing of amorphous (or very finely divided) materials.

47059 **Isotope dilution liquid chromatography.** Parus, S.J.; Shick, R.A.; Matsumura, M.; Morris, M.D. *Analytical Chemistry;* 60: No. 15, 1626-1629(1 Aug 1988). Contract AC02-76CH00016.

Isotope dilution analysis (IDA) has been historically used in situations where separation of an analyte from its matrix is difficult or imprecise. A requirement of IDA is that analyte mass be either measured or inferred for the determination of specific activity or its equivalent. Thus, two measurements are necessary: one of activity and one of mass, and the latter requirement frequently limits the sensitivity potentially available from IDA. Methods to circumvent the problem have been described, but these are usually subject to other constraints. For example, in substoichiometric IDA, equal amounts of analyte are isolated and counted before and after dilution, but the isolation of exactly equal quantities of material is usually difficult. This paper describes the principle of a new technique that couples IDA with carbon 14 to high-performance liquid chromatography (HPLC). It removes the need for a direct mass measurement and thereby greatly improves the sensitivity of IDA while retaining its high selectivity. Viewed from the chromatographic perspective, it offers a sensitive, analyte-specific procedure for indirect detection.

47060 **Cobalt phthalocyanine/cellulose acetate chemically modified electrodes for electrochemical detection in flowing streams. Multifunctional operation based upon the coupling of electrocatalysis and permselectivity.** Wang, J.; Golden, T.; Li, R. (New Mexico State Univ., Las Cruces (USA)). *Analytical Chemistry;* 60: No. 15, 1642-1645(1 Aug 1988).

Amperometric detection for flowing streams is greatly improved by the multifunctional character of Cobalt Phthalocyanine/Cellulose Acetate (CoPC/CA) coatings. The incorporation of CoPC into the CA domain has essentially no effect on the catalytic behavior. Such effective coupling of electrocatalysis and permselectivity provides a means for minimizing problems and extending the scope of electrochemical measurements in flowing streams. This study suggests also that cellulose acetate could be an ideal host material for the preparation of other powerful multifunctional coatings.

47061 **Neat and admixed mesomorphic polysiloxane stationary phases for open-tubular column gas chromatography.** Janini, G.M.; Muschik, G.M.; Issaq, H.J.; Laub, R.J. (Kuwait Univ.). *Analytical Chemistry;* 60: No. 11, 1119-1124(1 Jun 1988).

A mesomorphic polysiloxane (MEPSIL) solvent, employed either neat or in admixture with SE-30 poly(dimethylsiloxane) (PDMS) diluent, is shown to be a highly selective stationary phase for open-tubular column gas-liquid chromatography. Mixtures of cis and trans fatty acid methyl esters (FAME) are resolved isothermally in under 10 min with neat nematic MEPSIL phase, where trans isomers are retained longer than their cis counterparts. Programmed-temperature separations of more complex mixtures of FAME solutes also demonstrate that elution order is by increasing carbon number and that within a group of the same carbon number, retentions increase with increasing saturation, which is completely opposite to the order of selectivity given by conventional phases. Shape selectivity of the nematic MEPSIL phase is further illustrated by the separation of samples containing polychlorinated biphenyl (PCB) solutes, where inter alla congener 198 elutes well before 128. Blending the MEPSIL solvent with SE-30 is then shown not to depress significantly the nematic/isotropic transition of the pure mesomorph, and blends of up to 3:1 SE-30/MEPSIL are virtually as selective as neat MEPSIL at temperatures in excess of 300°C. However, the crystal/nematic transition cannot thereby be lowered substantially, nor can the lower limiting chromatographic efficiency be improved to much beyond that of the neat phase. Even so, blended-phase columns exhibit in excess of 3200 N m^{-1} at elevated temperatures, which is sufficient to provide good resolution, isothermally, of 8 of 10 methylbenz[a]anthracene isomers at 240°C, and of 9 of 10 methylbenzo[a]pyrene solutes at 275°C.

47062 **Particle separation and characterization by sedimentation/cyclical-field-flow fractionation.** Lee, S.; Myers, M.N.; Beckett, R.; Giddings, J.C. (Univ. of Utah, Salt Lake City (USA)). *Analytical Chemistry;* 60: No. 11, 1129-1135(1 Jun 1988). Contract FG02-86ER60431.

The first experimental implementation of cyclical-field field-flow fractionation (CyFFF), a proposed method in which the strength and/or direction of the applied field is cycled during a run, is described. The experimental system was designed for use with a gravitational driving force. Because gravity cannot be cycled, a system was designed in which the orientation of the channel was cycled relative to the gravitational field. The theory of this method was extended beyond that of earlier theoretical work to include steric effects due to finite particle size. The theory was tested under a variety of conditions; good agreement was found for all but the largest particles examined in the diameter range 5-26 μm. The method can be used to measure the sedimentation coefficient of particles and in some cases related parameters such as particle density. Finally, the separation of particles in the 10-20 μm diameter range is demonstrated.

47063 **Partial least-squares methods for spectral analyses. 1. Relation to other quantitative calibration methods and the extraction of qualitative information.** Haaland, D.M.; Thomas, E.V. (Sandia National Labs., Albuquerque, NM (USA)). *Analytical Chemistry;* 60: No. 11, 1193-1202(1 Jun 1988). Contract AC04-76DP00789.

Partial least-squares (PLS) methods for spectral analyses are related to other multivariate calibration methods such as classical least-squares (CLS), inverse least-squares (ILS), and principal component regression (PCR) methods which have been used often in quantitative spectral analyses. The PLS method which analyzes one chemical component at a time is presented, and the basis of each step in the algorithm is explained. PLS calibration is shown to be composed of a series of simplified CLS and ILS steps. This detailed understanding of the PLS algorithm has helped to identify how chemically interpretable qualitative spectral information can be obtained from the intermediate steps of the PLS algorithm. These methods for extracting qualitative information are demonstrated by use of simulated spectral data. The qualitative information directly available from the PLS analysis is superior to that obtained from PCR but is not complete as that which can be generated during CLS analyses. Methods are presented for selecting optimal numbers of loading vectors for both the PLS and PCR models in order to optimize the model while simultaneously reducing the potential for overfitting the calibration data. Outlier detection and methods to evaluate the statistical significance of results obtained from the different calibration methods applied to the same spectral data are also discussed.

47064 **Partial least-squares methods for spectral analyses. 2. Application to simulated and glass spectral data.** Haaland, D.M.; Thomas, E.V. (Sandia National Labs., Albuquerque, NM (USA)). *Analytical Chemistry;* 60: No. 11, 1202-1208(1 Jun 1988). Contract AC04-76DP00789.

Partial least-squares (PLS) methods for quantitative spectral analyses are compared with classical least-squares (CLS) and principal component regression (PCR) methods by using simulated data and infrared spectra from bulk seven-component, silicate-based glasses. Analyses of the simulated data sets show the effect of data pretreatment, base-line variations, calibration design, and constrained mixtures on PLS and PCR prediction errors and model complexity. Analyses of the simulated data sets also illustrate some qualitative differences between PSL and PCR. PLS and PCR predicted concentration errors from the simulated data sets and a set of the Fourier transform infrared spectra of silicate-based glasses (S-glass) show that prediction errors are not statistically different between these two methods for these individual data sets with limited numbers of samples. However, PLS and PCR are both superior to CLS methods in the case of the analysis of S-glass where only one analyte is known in the calibration samples and the components of unknown concentration overlap all the spectral features of the analyte components. CLS analysis precision significantly improves when the three known analyte concentrations (B_2O_3, P_2O_5, and OH) are used in the calibration. In this latter case, PLS and PCR

concentration predictions are unchanged, and although they each still yield a lower standard error of prediction than the CLS method, there is no longer strong statistical evidence that these differences between PLS or PCR and CLS are outside experimental error for the B_2O_3 component. The ability of CLS and PLS methods to provide chemically useful estimates of the pure-component spectra is also demonstrated.

47065 **Quantitative infrared analysis of borophosphosilicate films using multivariate statistical methods.** Haaland, D.M. (Sandia National Labs., Albuquerque, NM (USA)). *Analytical Chemistry;* 60: No. 11, 1208-1217(1 Jun 1988). Contract AC04-76DP00789.

Infrared (IR) spectroscopy can serve as a rapid method for the quantitative analysis of borophosphosilicate glass (BPSG) films on Si wafers for the microelectronics industry. The advantages of using statistically designed calibration sets are emphasized. Classical least-squares (CLS), partial least-squares (PLS), and principal component regression (PCR) methods are all found to provide improved precision over traditional peak-height measurements. The quantitative results from spectral measurements taken in transmission mode at both 0° and 60° incident angles were also compared. PLS and PCR methods yielded results that were comparable within the sampling error, and each exhibited a better analysis precision than that obtained from the CLS analysis. Both PLS and PCR methods yielded the best results when applied to the original 60° incident angle data, which was not corrected for film thickness. PLS and PCR analyses each gave a standard error of prediction (SEP) for boron of $\approx$ 0.1 wt% and $\approx$ 0.2 wt % for phosphorus for a set of 44 calibration samples which spanned a range of concentrations from 1 to 5 wt % B and 2 to 6 wt % P. The PLS and PCR methods applied to the IR spectra were also capable of monitoring film thickness with a SEP of 14 nm for films that varied in thickness from 430 to 1000 nm. The importance of using these full-spectrum multivariate methods for outlier sample detection is presented, and the ability to extract qualitative spectral information from the CLS and PLS calibrations is demonstrated.

47066 **Investigation of a fusion technique for the determination of total sulfur in geological samples by ion chromatography.** Stallings, E.A.; Candelaria, L.M.; Gladney, E.S. (Los Alamos National Lab., NM (USA)). *Analytical Chemistry;* 60: No. 11, 1246-1248(1 Jun 1988).

The authors have encountered the need for a rapid, accurate, precise, and sensitive method for measuring total sulfur in large numbers of geological samples. Numerous environmental studies of sulfur deposition due to sulfur dioxide emission from combustion and industry are currently under way. Several techniques for measuring total sulfur in soils and other silicate materials have been published including neutron activation analysis, thermal neutron capture prompt γ-ray spectrometry, inductively coupled plasma atomic emission spectrometry, isotope dilution mass spectrometry, X-ray fluorescence, turbidimetry, ion chromatography (IC), iodimetric titration, and fluorometry. However, none of these methods is completely satisfactory for routine analysis of large numbers of samples. Many have levels of detection that are inadequate for measuring low levels of total sulfur (<100 μg/g) often encountered in soils. Several utilize only aqueous extracts of the soils and do not provide a total sulfur determination. Others require extensive sample preparation, are susceptible to loss of sulfur during oxidation, or produce incomplete conversion of sulfur species to sulfate. The objective of this work was to evaluate the accuracy of IC determination of sulfate for Na_2O_2 soil fusions by comparing the results obtained for reference materials with literature values reported for other techniques. They were also interested in determining if this fusion method would be rapid enough to handle large numbers of samples.

47067 **Nondestructive depth profiling of rare-earth and actinide zeolites via Rutherford backscattering methods.** Baumann, S.A.; Strathman, M.D.; Suib, S.L. (Charles Evans and Associates, Redwood City, CA (USA)). *Analytical Chemistry;* 60: No. 10, 1046-1051(15 May 1988).

Rutherford backscattering (RBS) methods have been used to study rare-earth and actinide-ion-exchanged small pore (A) and large pore (Y) zeolites. A theoretical discussion of the RBS method and a novel method of data treatment are given. Experimental data for zeolites have been simulated and theoretical depth profiles have been determined. Both experimental and theoretical data suggest that uranyl-exchanged A zeolite has a large uranium to oxygen surface ratio while the corresponding Y zeolite has a large uranium to oxygen bulk ratio. Relative atomic fractions of all zeolite elements are also given.

47068 **Measurement of femtogram quantities of trace elements using an x-ray microprobe.** Giauque, R.D.; Thompson, A.C.; Underwood, J.H.; Wu, Y.; Jones, K.W.; Rivers, M.L. (Lawrence Berkeley Lab., CA (USA)). *Analytical Chemistry;* 60: No. 9, 855-858(1 May 1988). Contract AC03-76SF00098;AC02-76CH00016.

Femtogram quantities of trace elements in biological materials have been measured with an X-ray microprobe. The microprobe uses a pair of concave spherical mirrors which were coated with tungsten-carbon multilayers. Arranged in the Kirkpatrick-Baez geometry, the mirrors produce a focused and quasi-monochromated beam from the synchrotron white radiation beam. The beam spot size is less than 10 x 10 μm and the monochromated beam has a band-pass of 1 keV at 10 keV. Minimum detectable limits achieved varied from 3 to 70 fg for the elements Zn ($Z = 30$) to K ($Z = 19$).

47069 **Supersonic jet atomic spectroscopy with flame atomization.** Koutny, L.B.; Whitten, W.B.; Nolan, T.G.; Ramsey, J.M. (Oak Ridge National Lab., TN (USA)). *Analytical Chemistry;* 60: No. 9, 958-960(1 May 1988). Contract AC05-84OR21400.

The authors have recently shown that high-resolution laser spectra of flame-atomized samples can be obtained with a low-pressure sampling technique. They used a form of saturation spectroscopy to obtain Doppler-free spectra. Collision broadening was reduced to a negligible value by reducing the sample pressure to as low as 0.1 Torr. There were, however, sufficient velocity-changing collisions within the residual gas to produce strong background pedestals. Also, additional spectral lines due to crossover resonances were present, with background pedestals as well. Since these resonances occur midway between primary resonances, they produce no additional spectral information but instead are an unnecessary hindrance to quantitative high-resolution spectroscopy. The purpose of this note is to report an improved apparatus in which the sampled flame gases are measured in a supersonic expansion. Because of the low rate of velocity-changing collisions in the expansion, the authors can obtain spectra relatively free of the background pedestals previously observed. Furthermore, they can selectively detect the primary resonances and exclude some of the crossover resonances by spatially filtering the sample fluorescence. Thus, two major sources of potential interference in high-resolution spectral determinations, collision pedestals and crossover resonances, are removed. Hyperfine spectra of the sodium D_1 and D_2 lines measured in a supersonic expansion are presented.

47070 **Recent advances in microcolumn liquid chromatography.** Novotny, M. (Indiana Univ., Bloomington (USA)). *Analytical Chemistry;* 60: No. 8, 500A-510A(15 Apr 1988). Contract FG02-84ER60215.

In 1981 an article in Analytical Chemistry described a relatively new direction in modern liquid chromatography (LC). Since that time, microcolumn LC, which was initiated during the late 1970s, has undergone extensive development. Whereas the main purpose of the 1981 article was to acquaint the analytical chemistry community with some unique features of miniaturized LC systems and their potential for various separations and measurements, this article provides a summary of the recent progress in microcolumn LC and, once again, points out new directions. Owing to the small number of laboratories engaged in microcolumn LC prior to 1981, the earlier article was comprehensive of the various developments of that time. The present article necessarily excludes this luxury, because the number of papers and presentations in this area has grown substantially.

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REFER ALSO TO CITATION(S) 46232, 46242, 46474, 46475, 46529, 46705, 46767, 46966, 46992, 47352, 47506

47071 (DOE/ER/13276—T2) Characterization of catalysts with metal-support effects and of the species adsorbed on their surfaces: Final progress report, September 1, 1984--August 30, 1988. Vannice, M.A. (Pennsylvania State Univ., University Park (USA). Dept. of Chemical Engineering). Jan 1988. Contract FG02-84ER13276. 11p. NTIS, PC A03/MF A01; 1; GPO Dep. Order Number DE88013753/JAW.

Objectives of our current grant were: "to gain a better understanding of the chemistry and physics which produce these metal-support effects and, as a consequence, to use this information to guide us in the development of new and improved catalyst systems for particular reactions." We investigated Pt and Pd dispersed on selected supports using a multifaceted approach involving DSC, TGA, NMR, adsorption, and kinetic studies of selected probe selected probe reactions. This approach has led us to the preparation of: (1) the most active Pd catalysts to date for benzene hydrogenation; (2) the most active Pt catalysts to date (by more than an order of magnitude) for acetone hydrogenation to isopropanol; and (3) the only Pt catalysts capable of significant selectivity to crotyl alcohol during crotonaldehyde hydrogenation. Calorimetric studies using DSC have shown that the principal reason for decreased chemisorption capacity on TiO_2-supported Pt and Pd is the physical blockage of metal surface by TiO/sub x/ species rather than by a large decrease in the heats of adsorption, Q/sub ad/. Also, with Pd a large crystallite size effect was found which increased Q/sub ad/ values on particles smaller than 3 nm. 4 figs.

47072 (DOE/ER/13295—2) Transition metal mediated transformations of unsaturated molecules: Progress report. Sen, A. (Pennsylvania State Univ., University Park (USA). Dept. of Chemistry). 1 Jul 1988. Contract FG02-84ER13295. 5p. NTIS, PC A02/MF A01; 1; GPO Dep. Order Number DE88013482/JAW.

The catalysis of organic transformations by soluble transition metal compounds has gained widespread attention because of the high efficiency, high specificity and low energy demands often associated with such systems. Research goals in this area are: (a) to achieve a fundamental mechanistic understanding of the important homogeneous catalytic systems and, (b) to use this knowledge to develop new and useful catalytic processes. We have focused on four broad areas of transition metal catalyzed/mediated transformations of organic molecules: (a) the selective functionalization of alkanes and arenas by electrophilic metal compounds, (b) the coupling of organic mono- and dihalides by low-valent, anionic, metal complexes, (c) transition metal mediated/catalyzed reactions of carbon monoxide, and (d) the oxidation chemistry of high-valent organometallic oxo complexes. Results are briefly summarized below.

47073 (DOE/ER/13569—2) Transition metal activation and functionalization of C-H bonds: Progress report, December 1, 1987-November 30, 1988. Jones, W.D. (Rochester Univ., NY (USA). Dept. of Chemistry). Aug 1988. Contract FG02-86ER13569. 36p. NTIS, PC A03/MF A01; 1; GPO Dep. Order Number DE88014626/JAW.

This project is directed towards the continued investigation of the fundamental thermodynamic and kinetic factors that influence carbon-hydrogen bond activation at homogeneous transition metal centers. The project is also directed towards the conversion of hydrocarbons into functionalized products of potential use to chemical industry. Goals will be 1) to identify new transition metal complexes capable of activating arene and alkane C-H bonds, 2) to quantitatively evaluate the kinetic and thermodynamic stability of these complexes, and 3) to examine routes for functionalization of the activated hydrocarbons. Specific complexes involved are derivatives of the formulation $(C_5Me_5)Rh(PR_3)(R)H$, $Fe(PMe_3)_2(CNR)_3$, $Ru(PR_3)_4(R)H$, and $Rh(CNR)_3H$. Functionalization will focus upon isocyanide and acetylene insertion reactions. New compounds that activate hydrocarbon C-H bonds include $HRe(PR_3)_5$, $HRe(PR_3)_2(CNR)_3$, $CpRe(PR_3)H_4$, $CpRe(PR_3)_2H_2$, $(\{eta\}^6\text{-}C_6H_6)Re(PPh_3)_2H$, and $MnH_3(dmpe)_2$. The latter complex is found to be an {eta}^{2}-dihydrogen complex. The new complexes $RhCl[P(i\text{-}Pr)_3]_2(CNCH_2CMe_3)$ and (trispyrazolylborate)$Rh(CNR)_2$ are shown to be active for the activation and functionalization of aromatic C-H bonds. 10 figs., 1 tab.

47074 (DOE/ER/13579—20) Variational transition state theory: Progress report. Truhlar, D.G. (Minnesota Univ., Minneapolis (USA). Dept. of Chemistry). 1 Mar 1988. Contract FG02-86ER13579. 4p. NTIS, PC A02/MF A01; 1; GPO Dep. Order Number DE88013756/JAW.

This project is concerned with the development and applications of generalized transition state theory and multidimensional tunneling approximations to chemical reaction rates. We have developed and implemented several practical versions of variational transition state theory (VTST), namely, canonical variational theory (CVT), improved canonical variational theory (ICVT), and microcanonical variational theory (μVT). We have also developed and implemented several accurate multidimensional semiclassical tunneling approximations, the most accurate of which are the small{emdash}curvature semiclassical adiabatic (SCSA), large{emdash}curvature version{emdash}3 (LC3), and least{emdash}action (LA) approximations. We have applied the methods to thermal rate constants, using transmission coefficients based on ground{emdash}state tunneling and we have also presented and applied adiabatic and diabatic extensions to calculate rate constants for vibrationally excited reactants. Our general goal is to develop accurate methods for calculating chemical reaction rate constants that remain practical even for reasonably complicated molecules. The approximations mentioned above yield rate constants for systems whose potential energy surface is known or assumed. Thus a second, equally important aspect of our work is the determination or modeling, semiempirically and/or from electronic structure calculations, of potential energy surfaces. In this regard we have developed and implemented new flexible procedures for representing the potential surfaces of reactive systems by global and semiglobal analytic functions. Finally, a new initiative is concerned with including variational and tunneling effects in a thermochemical data base.

47075 (DOE/ER/13650—T1) The effect of catalyst preparation on catalyst activity: Progress report for the period December 1, 1987 through November 30, 1988. Schwarz, J.A. (Syracuse Univ., NY (USA). Dept. of Chemical Engineering and Materials Science). 1988. Contract FG02-87ER13650. 8p. NTIS, PC A02/MF A01; 1; GPO Dep. Order Number DE88014505/JAW.

The objective of the research in our laboratory has been to examine the effect of formulation procedures on the catalytic properties of supported-metal catalyst systems and determine the extent to which metal-support interactions account for their novel characteristics. Catalysts studied include: Ru/Al_2O_3, and Rh/SiO_2. Preparation methods and results are briefly described.

47076 (DOE/ER/60517—2) Energy transformation in molecular electronic systems: Progress report, December 1, 1987-November 30, 1988. Kasha, M. (Florida State Univ., Tallahassee (USA). Inst. of Molecular Biophysics). 29 Jul 1988. Contract FG05-87ER60517. 10p. NTIS, PC A02/MF A01; 1; GPO Dep. Order Number DE88014737/JAW.

Research on proton-transfer spectroscopy is reported. The key findinga include (1) observation of excited state proton-transfer in a peptide (benzanilide), (2) the discovery of an extraordinary charge-transfer fluorescence emission in N-methylbenzanilide, which helped to clarify the presence of a dual-fluorescence (in addition to the normal fluorescence) of benzanilide itself, (3) the demostration of an anion-intermediate in the picosecond time-resolved spectroscopy of lumichrome, (4) further studies on the intramolecular proton-transfer laser, including pulse characteristics, and (5) resolution of the non-lasing cases of proton-transfer fluorescence, by SCF calculation and by picosecond time-resolved spectroscopy.

47077 **(DOE/ER/71128—T1) Thermodynamics of the adsorption of poisons on metal catalyst surfaces: Final report.** McCarty, J.G.; Wood, B.J. (SRI International, Menlo Park, CA (USA). Materials Research Lab.). Jun 1988. Contract AT03-77ER71128. 19p. (SRI-PYU—6776). NTIS, PC A03/MF A01; 1; GPO Dep. Order Number DE88014117/JAW.

The initial purpose of this research program was to determine quantitatively the thermodynamic basis for the poisoning of metal catalysts by sulfur compounds. The scope was broadened early in the research to include measurements of the rates of diffusion of sulfur atoms on well-defined metal surfaces. The thermodynamics of halogen chemisorption on supported nickel catalysts was included near the end of the contract. The effect of sulfur poisoning on the thermodynamics of carbon formation on nickel surfaces was included at the end of the contract; this work continues under a new project (SRI Project 3385). The results of these studies have greatly enhanced our quantitative understanding of the deactivation of metal catalysts by poisoning.

47078 **(IC—88/39) Normal vibration and molecular force constant studies of poly-β-propiolactone.** Wang Kelin; Hu Fengming; Cheng Jafu. (International Centre for Theoretical Physics, Trieste (Italy); China Univ. of Science and Technology, Hefei, AH. Center of Fundamental Physics). (International Centre for Theoretical Physics, Trieste (Italy)). Feb 1988. 12p. NTIS (US Sales Only), PC A03/MF A01. Order Number DE88703839/JAW.

In this paper we shall give the band assignments of the IR spectra of poly-β-propiolactone and calculate the molecular force constants and normal vibrations of the molecule. (author). 4 refs, 6 tabs.

47079 (INIS-BR—1157, pp 79) **Kinetic of hydride precipitation during the cooling of Nb-H alloys.** Florencio, O.; Pinatti, D.G. (Sao Carlos Univ. (Brazil). Dept. de Engenharia de Materiais). 1981. (In Portuguese). NTIS (US Sales Only), PC A06/MF A01. Order Number DE88703560/JAW. (CONF-8109291—).

From 7. Latin American symposium on solid state physics; Gramado, Brazil (14 Sep 1981).

47080 (INIS-BR—1164, pp 15) **Luminescence suppression reaction of the UO/sub 2//sup ++/ ion excited state by monovalent anions.** Santarine, G.A. (UNESP, Presidente Prudente (Brazil). Inst. de Planejamento e Estudos Ambientais). 1987. (In Portuguese). NTIS (US Sales Only), PC A09/MF A01. Order Number DE88703566/JAW. (CONF-8705181—).

From 10. national meeting on condensed matter physics; Caxambu, Brazil (5 May 1987).

47081 (INIS-BR—1164, pp 33) **Aggregation kinetics of silica sols.** Lours, T.; Zarzycki, J.; Craievich, A.F.; Santos, D. dos; Aegerter, M.A. (Montpellier-2 Univ., 34 (France); Centro Brasileiro de Pesquisas Fisicas, Rio de Janeiro; Sao Paulo Univ., Sao Carlos, SP (Brazil). Inst. de Fisica e Quimica). 1987. (In Portuguese). NTIS (US Sales Only), PC A09/MF A01. Order Number DE88703566/JAW. (CONF-8705181—).

From 10. national meeting on condensed matter physics; Caxambu, Brazil (5 May 1987).

47082 (INIS-BR—1164, pp 72) **System for deposition of thin organic polymer films produced in plasmas - RF.** Maciel, H.S.; Amorim Filho, J. de; Stempniak, R.A.; Speller, C.V.; Moraes, M.A.B. de. (Centro Tecnico Aeroespacial, Sao Jose dos Campos (Brazil). Inst. Tecnologico de Aeronautica; Universidade Estadual de Campinas (Brazil). Inst. de Fisica). 1987. (In Portuguese). NTIS (US Sales Only), PC A09/MF A01. Order Number DE88703566/JAW. (CONF-8705181—).

From 10. national meeting on condensed matter physics; Caxambu, Brazil (5 May 1987).

47083 **(Juel—2136) Precision density measuring equipment: Design, selected examples.** Karasinski, T.; Patzelt, K.; Dieker, C.; Hansen, H.; Wenzl, H.; Schober, T. (Kernforschungsanlage Juelich G.m.b.H. (Germany, F.R.). Inst. fuer Festkoerperforschung). Jun 1987. 55p. (In German). NTIS (US Sales Only), PC A04/MF A01. Order Number DE88754600/JAW.

The report deals with solids density measurement using the pyknometer, the hydrostatic balance, or the floating specimen method. The mathematical relations are derived, and error sources are shown. A detailed description is given of a measuring set-up for measuring the density of solids and liquids. An error calculation is presented. After explaining the determination of density of a standard solid body, the report describes the density measurement of monocrystalline germanium, of niobium-tritide, Ni/sub 3/Al, Ge-Si, and gallium arsenide, the determination of space-lattice expansion by hydrogen isotopes, and of the purity of H-D mixtures.

47084 **(LBL—25410) Chemical reaction rates via the flux correlation function.** Tromp, J.W. (Lawrence Berkeley Lab., CA (USA)). May 1988. Contract AC03-76SF00098. 101p. NTIS, PC A06/MF A01; 1; GPO Dep. Order Number DE88013591/JAW.

It is shown that the exact thermally averaged quantum mechanical rate constant of a chemical reaction can be obtained as the time integral of a reactive flux correlation function. This correlation function measures the time dependent correlation of reactive flux through a dividing surface separating reactants and products. The properties of the correlation function are then investigated, first for barrier passage problems in one dimension. The correlation functions are obtained for three different collinear reactions ($H + H_2$, $Cl + HCl$, and $F + H_2$), both quantum mechanically and classically. The features of the correlation functions can be interpreted in terms of the known dynamics of these reactions, and show the effects of direct tunneling, classical recrossing, and complex formation respectively. Finally, a discrete Feynman path integral method is developed, where the multidimensional nature of the problem is treated through the introduction of an influence functional. The path integral is done by Monte Carlo and yields values of the correlation function for purely imaginary times. Real time values are obtained by analytic continuation. This method is tested on the collinear $H + H_2$ reaction, where it yields good results and can be readily extended to multidimensional systems. 44 refs., 16 figs., 4 tabs.

47085 **(MLM—3500(OP)) Characterization of consolidated and plasma sprayed aluminum/iron oxide thermites by SEM [secondary electron microscopy], AES [Auger electron spectroscopy], and EDS [energy dispersive spectroscopy].** Foose, D.S.; Kelly, M.D.; Haws, L.D.; Moddeman, W.E. (Monsanto Research Corp., Miamisburg, OH (USA). Mound). 1988. Contract AC04-76DP00053. 6p. (CONF-880473—6). NTIS, PC A02/MF A01; 1; GPO Dep. Order Number DE88012866/JAW.

From American Defense Preparedness Association Compatibility symposium; New Orleans, LA, USA (18 Apr 1988).

Secondary electron microscopy (SEM), Auger electron spectroscopy (AES) and energy dispersive spectroscopy (EDS) were used to characterize two types of aluminum/Fe_3O_4 thermites, the first prepared by consolidating the powders into a pellet and the second prepared by spraying the powders in an Ar plasma. The aim was to examine the chemistry of these materials, with particular emphasis on the interfacial region of the fuel and oxidizer. The consolidated thermite was composed of spheroidal iron oxide particles distributed throughout a continuous aluminum metal phase whereas the plasma sprayed thermite was composed of two continuous phases, one being an iron oxide phase and the other being an aluminum metal phase. A comparison of an iron oxide-aluminum metal interface of each showed a greater degree of intermixing of the phases in the plasma sprayed thermite than in the consolidated one. 2 refs., 6 figs.

47086 **(MLM—3524(OP)) Dilute and not so dilute impurities in tritium.** McConville, G.T. (Monsanto Research Corp., Miamisburg, OH (USA). Mound). 1988. Contract AC04-76DP00053. 6p. (CONF-8806172—1). NTIS, PC A02/MF A01; 1; GPO Dep. Order Number DE88012884/JAW.

From Synthesis and applications of isotopically labelled compounds; Innsbruck, Austria (17 Jun 1988).

The reactivity of tritium is largely determined by a steady state ion concentration of about one part in 10^9 of the background molecules. These ions determine the reaction rates with other materials, and impurities of the order of 1 ppM can be shown to determine on which species the ion resides. In pure tritium, T_3^+ changes to T_5^+ as the pressure is increased above a few thousand pascals (10 torr). In the presence of common impurities, the ions CT_3^+, T_3O^+, and N_2T^+ become dominant. Rarely, because of the large energy involved, N^+ is formed which leads to NT_4^+. It is shown that when the ion resides on the impurity such as CH_4T^+, the exchange only takes place during methane-methane collisions and thus it is slow. 10 refs., 2 figs., 1 tab.

47087 **(MLM—3526(OP)) Characterization of consistent NDA [nondestructive assay] standards.** Rodenburg, W.W.; Novak, E.F.; Seiler, R.J. (Monsanto Research Corp., Miamisburg, OH (USA). Mound). 1988. Contract AC04-76DP00053. 5p. (CONF-880631—20). NTIS, PC A02/MF A01; 1; GPO Dep. Order Number DE88012883/JAW.

From 29. annual meeting of the Institute of Nuclear Materials Management; Las Vegas, NV, USA (26 Jun 1988).

By combining calorimetry and traditional analytical methods five sets of unique NDA standards were characterized for the Savannah River Plant (SRP) of E.I. Du Pont de Nemours, Inc. The calorimetry measurements make it possible to nondestructively verify the homogeneity of the plutonia stock and to assure that the analytical aliquots were representative of the parent material. Two assay values were determined by calorimetric assay. When the isotopic composition was determined by mass spectroscopy and alpha pulse height analysis, the agreement between Pu content by calorimetry and controlled potential coulometry was within 0.06% for all five isotopic compositions. When nondestructive, gamma-ray isotopic techniques were used to assay the 1500 gram standards the agreement was within 0.1% for all five materials. The new half-lives and specific power recommended in the latest revision of ANSI N15.22-1987, Calibration Techniques for the Calorimetric Assay of Plutonium Bearing Solids were used for all computations. The standards were certified for plutonium content, isotopic composition, and thermal power. The mass of the standards varied from 20 to 1500 grams with ^{240}Pu compositions ranging from 3 to 15 percent. 7 tabs.

47088 (PNL-SA—15217, pp 281-291) **Environmental transformations of polycyclic aromatic hydrocarbons on glass surfaces.** Benson, J.M.; Brooks, A.L.; Cheng, Y.W.; Henderson, T.R.; White, J.E. (Lovelace Toxicology Research Institute, Albuquerque, NM (USA)). 1987. NTIS, PC A99/MF A01. Order Number DE88007332/JAW. (CONF-851027—). Contract AC04-76EV01013.

From 24. Hanford life sciences symposium and environmental research on complex organic mixtures; Richland, WA, USA (20 Oct 1985).

The authors investigated the environmental transformation of anthracene (A), 2-aminoanthracene (2-AA), benzo[a]pyrene (BaP), and 1-nitropyrene (NP) to understand the fate of PAH released to the atmosphere. Glass plates coated with ^{14}C-labeled compounds were exposed continuously outdoors for periods ranging from 1 to 670 hr. Control plates were held in the dark. Breakdown products were separated from parent compound by high-performance liquid chromatography, quantified by liquid scintillation spectroscopy, and identified by standard spectroscopic techniques. Decomposition of A and 2-AA was almost total during 4-hr sunlight exposure. The NP decay rate could be fitted with a two-component exponential function; the half-lives of the rapid and slower components of breakdown were 14 and 533 hr, respectively. The BaP decay rate could be fitted with a single exponential function, with a half-life of 460 hr. 2-Nitrosoanthracene was tentatively identified as a decomposition product of 2-AA. The BaP was oxidized to phenol and quinone derivatives. Breakdown of NP involved loss of the nitro group and formation of a phenol, a dione, and a diol. Mutagenic activities of isolated NP breakdown products in Salmonella tester strain TA98 were significantly less than that of NP, probably reflecting loss of the nitro group. Studies are needed to determine if these results apply to particle-associated PAH.

47089 **(UA—8013606) Kinetics of methyl tertiary butyl ether synthesis: Final report for project year 1986/87.** Hatcher, W.J. Jr.; Pien, S.I. (Alabama Univ., University (USA). Dept. of Chemical Engineering). Nov 1987. 63p. School of Mines and Energy Development, Box 6282, Univ. of Alabama, Tuscaloosa, AL 35486. Order Number TI88013606/JAW.

Methyl tertiary butyl ether (MTBE) has been accepted worldwide as an octane booster, and the demand for MTBE has grown rapidly as the use of tetraethyl lead and similar lead containing compounds have been phased out due to concerns about the effect of lead compounds on health. MTBE is formed by the reaction of isobutene with methanol, an acid cation exchange resin as often with catalyst. In this study, the catalytic activity of a zeolite, H-ZSM-5, was evaluated in a fixed-bed micro-reactor at 75 to 115{degree}C. Isobutene conversions ranged from 10 to 89{percent} and were completely selective to the formation of MTBE. Dimer formation was hindered by the unique pore size of the zeolite. Temperature and isobutene-to-catalyst ratio were the significant process variables. Pressure had no significant effect on conversion of the liquid phase reaction. The reaction rate was zero order with respect to methanol concentration and was correlated by a first order reversible reaction equation. This zeolite may have selectivity and stability advantages over the present commercial catalyst. 12 figs., 5 tabs.

47090 **(UCRL—98040) A detailed chemical kinetic reaction mechanism for the oxidation of iso-octane and n-heptane over an extended temperature range and its application to analysis of engine knock.** Westbrook, C.K.; Warnatz, J.; Pitz, W.J. (Lawrence Livermore National Lab., CA (USA)). 11 Jan 1988. Contract W-7405-ENG-48. 21p. (CONF-880802—2). NTIS, PC A03/MF A01; 1; GPO Dep. Order Number DE88005370/JAW.

From 22. international symposium on combustion; Seattle, WA, USA (14 Aug 1988).

A detailed chemical kinetic reaction is developed to describe the oxidation of n-heptane, iso-octane, and their mixtures over a wide range of operating conditions. In addition to a high temperature submechanism, reaction paths are included to describe the lower temperature regimes in which the rate and intermediate products of oxidation are controlled by addition of molecular oxygen to alkyl and isomerized alkylperoxy radicals, internal H atom abstractions, and reactions involving O-heterocyclic species. The mechanism is then used to study the influence of fuel composition on knocking in internal combustion engines. Autoignition of mixtures of iso-octane and n-heptane is examined. The computations reproduce the variations of autoignition delay time with octane number and these variations are interpreted in terms of detailed differences in the structure of the two primary reference fuels. Sensitivity analyses of the computations are also presented. 30 refs., 2 figs.

47091 **(UCRL—99009) Dissociative recombination of HCO^+: Complete active space (CAS) SCF electronic structure calculations.** Kraemer, W.P.; Hazi, A.U. (Lawrence Livermore National Lab., CA (USA)). 17 Jun 1988. Contract W-7405-ENG-48. 13p. (CONF-8805162—2). NTIS, PC A03/MF A01; 1; GPO Dep. Order Number DE88014140/JAW.

From International symposium on dissociative recombinations, theory, experiment and applications; Alberta, Canada (28 May 1988).

Laboratory measurements of the dissociative recombination of electrons with HCO/sup {plus}/ ions were performed using the stationary microwave afterglow technique as well as in a flowing afterglow Langmuir probe (FALP) experiment. CASSCF calculations suggest that the recombination of vibrationally cold HCO/sup {plus}/ ions with low-energy electrons can only proceed via an indirect reaction mechanism. Three different dissociation channels are in principle available to stabilize the intermediate states formed by

electron capture. Dissociation can occur along the repulsive potentials of the X $^2\Sigma$/sup {plus}/ and of the first excited $^2\Sigma$/sup {plus}/ and ^{2}{Pi} states of HCO. Different electronic states of CO are produced in the three different dissociation channels and their exothermicities vary from ΔE/sub e/ = 7.1 eV for CO (X $^1\Sigma$/sup {plus}/) to ΔE/sub e/ = 1.1 eV for CO (a ^{3}{Pi}) and finally to ΔE/sub e/ = 0.2 eV for CO (a' $^3\Sigma$/sup {plus}/). 11 refs., 3 figs.

47092 **Fundamental equation for systems in chemical equilibrium.** Alberty, R.A.; Oppenheim, I. (Department of Chemistry, Massachusetts Institute of Technology, Cambridge, Massachusetts 02139). *Journal of Chemical Physics;* 89: No. 6, 3689-3693(15 Sep 1988).

At constant temperature and pressure, the differential of the Gibbs energy can be written in terms of species, components, extents of reaction, isomer groups, and homologous series groups under specified conditions. The applicability of each of these options in deriving expressions for equilibrium constants and devising other methods for calculating equilibrium compositions is discussed. If one or more reactants are available to a system at a constant chemical potential, their terms can be removed from the summation by use of a Legendre transform to obtain a new thermodynamic potential that is a minimum at equilibrium. This pemits the definition of homologous series and other groups that can be used as single terms in the fundamental equation for the purpose of equilibrium calculations. By use of these techniques, calculations can be made on organic systems with indefinitely large numbers of species.

47093 **Polar solvent relaxation: The mean spherical approximation approach.** Nichols A.L. III; Calef, D.F. (Lawrence Livermore National Laboratory, University of California, Livermore, California 94550). *Journal of Chemical Physics;* 89: No. 6, 3783-3788(15 Sep 1988).

The use of the mean spherical approximation (MSA) in the study of dynamics of polar fluids is further explored in two ways. First, the recent result of Wolynes [J. Chem. Phys. 86, 5133 (1987)] showing that solvation dynamics can be extracted from the static solution of the MSA is further investigated. The solvation of a dipole in a dipolar fluid is calculated, and compared with an ion in a dipolar fluid. Both cases reduce to simple numerical quadrature. Second, the Smoluchowski—Vlasov equation (SVE) of Calef and Wolynes [J. Chem. Phys. 78, 4145 (1983)] is also reexamined. Using the analytic MSA results, a new set of relaxation times can be defined. In both sections, structural relaxation occurs with multiple relaxation times.

47094 **Semiclassical Gaussian wave packet dynamics for collinear reactive scattering.** Kress, J.D.; DePristo, A.E. (Ames Laboratory-USDOE and Deparment of Chemistry, Iowa State University, Ames, Iowa 50011). *Journal of Chemical Physics;* 89: No. 5, 2886-2893(1 Sep 1988).

The dynamics of collinear exchange reactions is treated within a semiclassical Gaussian wave packet (GWP) description. Two extensions to the previous methodology of GWP dynamics are presented. The first involves the evaluation of the interaction picture wave function propagators directly via the GWP solution to the time-dependent Schroedinger equation. The second involves use of a sum of GWPs to represent the initial translational plane wave on a finite interval. As usual, the vibrational wave function is also represented as a sum of GWPs, where the expansion coefficients are chosen to yield the desired initial vibrational state. The limitations of the previous GWP dynamical methods as applied to the reactive scattering problem are pointed out and the solutions provided by the present extensions are discussed. Results for the H+H_2 collinear exchange reaction using the Porter—Karplus II potential energy surface are shown.

47095 **Application of adiabatic switching to vibrational energies of three-dimensional HCO, H_2O, and H_2CO.** Sun, Q.; Bowman, J.M.; Gazdy, B. (Department of Chemistry, Emory University, Atlanta, Georgia 30322). *Journal of Chemical Physics;* 89: No. 5, 3124-3130(1 Sep 1988).

Semiclassical vibrational energies are calculated for nonrotating, three-dimensional HCO, H_2O, and H_2CO by the adiabatic switching method. For HCO and H_2O the Hamiltonian is given in a body-fixed frame in terms of Jacobi coordinates. Several zero-order Hamiltonians for adiabatic switching to the full Hamiltonian are considered. The simple, "obvious" choices do not yield stable results; however, a nonseparable zero-order Hamiltonian, which can be transformed to a simple normal form, does give stable results. Semiclassical quantization is done with the transformed zero-order Hamiltonian, initial conditions are obtained in terms of the Jacobi coordinates, and adiabatic switching is done in these coordinates. The Watson Hamiltonian is used for H_2CO in a straightforward fashion. In all cases, the semiclassical energies are in good agreement with quantum mechanical results, and for H_2O in excellent agreement with other semiclassical results.

47096 **Molecular model for aqueous ferrous—ferric electron transfer.** Kuharski, R.A.; Bader, J.S.; Chandler, D.; Sprik, M.; Klein, M.L.; Impey, R.W. (Department of Chemistry, University of California, Berkeley, California 94720). *Journal of Chemical Physics;* 89: No. 5, 3248-3257(1 Sep 1988).

We present a molecular model for studying the prototypical ferric—ferrous electron transfer process in liquid water, and we discuss its structural implications. Treatment of the nonequilibrium dynamics will be the subject of future work. The elementary constituents in the model are classical water molecules, classical ferric ions (i.e., Fe^{3+} particles), and a quantal electron. Pair potentials and pseudopotentials describing the interactions between these constituents are presented. These interactions lead to ligand structures of the ferric and ferrous ions that are in good agreement with those observed in nature. The validity of the tight binding model is examined. With umbrella sampling, we have computed the diabatic free energy of activation for electron transfer. The number obtained, roughly 20 kcal/mol, is in reasonable accord with the aqueous ferric—ferrous transfer activation energy of about 15 to 20 kcal/mol estimated from experiment. The Marcus relation for intersecting parabolic diabatic free energy surfaces is found to be quantitatively accurate in our model. Due to its significance to future dynamical studies, we have computed the tunnel splitting for our model in the absence of water molecules. Its value is about 1 k/sub B/ T at room temperature for ferrous—ferric separations around 5.5 A. This indicates that the dynamics of the electron transfer are complex involving both classical adiabatic dynamics and quantal nonadiabatic transitions. The dynamics may also be complicated due to glassy behavior of tightly bound ligand water molecules. We discuss this glassy behavior and also describe contributions to the solvation energetics from water molecules in different solvation shells. Finally, the energetics associated with truncating long ranged forces is discussed and analyzed.

47097 **Adsorption kinetics of surfactant molecules at a liquid—air interface.** Rasing, T.; Stehlin, T.; Shen, Y.R.; Kim, M.W.; Valint P. Jr. (Department of Physics, University of California, Center for Advanced Materials, Lawrence Berkeley Laboratory, Berkeley, California 94720). *Journal of Chemical Physics;* 89: No. 5, 3386-3387(1 Sep 1988).

The adsorption of the surfactant sodium—dodecyl naphthalene—sulfonate from the bulk to the water—air interface was studied by optical second harmonic generation. An initial rapid Langmuir type of adsorption to about 80% of a monolayer is observed, followed by a much slower adsorption until a full monolayer is formed.

47098 **Laser desorption time-of-flight mass spectrometry using a 300-ps ultraviolet laser.** Huang, L.Q.; Conzemius, R.J.; Junk, G.A.; Houk, R.S. (Ames, Lab., IA (USA)). *Analytical Chemistry;* 60: No. 15, 1490-1494(1 Aug 1988). Contract W-7405-ENG-82.

An N_2 laser (λ = 337 nm) was used with a linear time-of-flight mass spectrometer to study ion formation from metal films, CaI, and sucrose. Improved techniques were incorporated for fast ion detection and data acquisition. For inorganic specimens the mass resolution was ~ 1500 (full width at half-maximum) at m/z 400, a considerable improvement over earlier reports for instruments using a laser desorption ion source and a linear ion optical path. Cationized parent ions and structurally significant fragments were obtained from sucrose, in contrast to previous observations and predictions for subnanosecond UV laser desorption.

47099 **Evaluated Chemical Kinetic Data for the Reactions of Atomic Oxygen O(³P) with Saturated Organic Compounds in the Gas Phase.** Herron, J.T. (Chemical Kinetics Division, Center for Chemical Physics, National Bureau of Standards, Gaithersburg, Maryland 20899). *Journal of Physical and Chemical Reference Data;* **17**: No. 3, 967-1026(Jul 1988).

Rate constants and mechanisms for the gas phase reactions of atomic oxygen O(³P) with organic compounds having only saturated C—C bonds are compiled and critically evaluated. Data are given for the alkanes, cycloalkanes, haloalkanes, oxygen and nitrogen containing organic compounds, and free radicals. In addition, data are given for some miscellaneous compounds containing boron, silicon, germane, and mercury. From a critical examination of the data, recommended values for rate constants are given over specified temperature intervals or at specified temperatures. Error limits are assigned to all recommended values.

47100 **Rate Constants for Reactions of Inorganic Radicals in Aqueous Solution.** Neta, P.; Huie, R.E.; Ross, A.B. (Chemical Kinetics Division, National Bureau of Standards, Gaithersburg, Maryland 20899). *Journal of Physical and Chemical Reference Data;* **17**: No. 3, 1027-1284(Jul 1988).

Rate constants have been compiled for reactions of various inorganic radicals produced by radiolysis or photolysis, as well as by other chemical means in aqueous solutions. Data are included for the reactions of xCO^-_2, xCO^-/sub 3</sub x//sub =/, O_3, xN_3, xNH_2, xNO_2, NO/sub 3</sub x//sub =/, xPO/sup 2-/$_3$, PO/sup 2-//sub 4</sub x//sub =/, SO^-/sub 2</sub x//sub =/, xSO^-_3, SO^-/sub 4</sub x//sub =/, SO^-/sub 5</sub x//sub =/, SeO^-/sub 3</sub x//sub =/, $(SCN)^-$/sub 2</sub x//sub =/, Cl^-/sub 2</sub x//sub =/, Br^-/sub 2</sub x//sub =/, I^-/sub 2</sub x//sub =/, ClO/sub 2</sub x//sub =/, BrO/sub 2</sub x//sub =/, and miscellaneous related radicals, with inorganic and organic compounds.

47101 **Study of recombination reaction $CH_3 + CH_3 \rightarrow C_2H_6$. 1. Experiment.** Slagle, I.R.; Gutman, D.; Davies, J.W.; Pilling, M.J. (Illinois Institute of Technology, Chicago (USA)). *Journal of Physical Chemistry;* **92**: No. 9, 2455-2462(5 May 1988).

The recombination of methyl radicals has been studied as a function of temperature and bath gas density to obtain more detailed knowledge of the kinetics of this reaction in the unimolecular falloff region. The reaction was studied by two techniques: (1) use of a tubular reactor coupled to a photoionization mass spectrometer; (2) use of absorption spectroscopy with a stainless steel flow cell. In both cases, methyl radicals were generated homogeneously by the pulsed photolysis of acetone at 193 nm. CH_3 decay profiles were monitored in real-time experiments. Absolute CH_3 concentrations were obtained from direct measurements of acetone photodecomposition in the photoionization experiments and from previously determined cross sections in the absorption experiments. Rate constants for the $CH_3 + CH_3$ reaction are reported, with argon as the bath gas, at nine temperatures in the range 296-906 K and at gas densities from 1.8×10^{16} to 1.4×10^{19} molecules cm^{-3}. A significantly narrower range of conditions was used in additional experiments using helium as the bath gas. The results obtained are compared with theoretical values of the $CH_3 + CH_3$ recombination rate constant obtained in part 2 (following paper in this issue). The combined results of the experimental and theoretical study of this reaction provide a more quantitative description of the role of collisions in this important recombination process. The uncertainty associated with extrapolating unimolecular rate constants to higher temperatures by using a common functional representation of the pressure and temperature dependence of such rate constants is illustrated with a comparison of theory and extrapolatioon up to 2000 K for the $CH_3 + CH_3$ high-pressure-limit rate constant.

47102 **Study of the recombination reaction $CH_3 + CH_3 \rightarrow C_2H_6$. 2. Theory.** Wagner, A.F.; Wardlaw, D.M. (Argonne National Lab., IL (USA)). *Journal of Physical Chemistry;* **92**: No. 9, 2462-2471(5 May 1988). Contract W-31-109-ENG-38.

A microcanonical variational RRKM rate constant calculation, based on the flexible transition-state theory of Wardlaw and Marcus (Chem. Phys. Lett. 1984, 110, 230) and an adjustable semiempirical potential energy surface, is compared to the measurement of part 1 (preceding paper in this issue) and other experimental studies. The calculations contain two adjustable parameters: a potential parameter α, which influences the tightness of the transition state, and $<\Delta E>$/sub tot/, the total average energy change in metastable $C_2H_6^*$ per collision with the buffer gas. When the parameters are optimized, the resulting calculated rate constants have a 9.9% root mean square error with respect to the measurements in Ar buffer gas. The final parameter values are $\alpha = 0.70 +/- 0.13$ A^{-1} and $<\Delta E>$/sub tot/ = -205 +/- 65 cm^{-1}. Similar calculations for He buffer gas produce 22.4% error when compared to the less extensive measurements and give an optimized $<\Delta E>$/sub tot/ value of about -135 cm^{-1}. The rate calculations for Ar buffer gas have been extended to 2000 K and then fit over the full temperature and pressure range to a modification of the functional form of Gilbert et al. (Ber. Bunsen-Ges. Phys. Chem. 1983, 87, 161). The resulting fitted functions required by that form are $k_0 = 8.76 \times 10^{-7}$T/sup -7.03/e/sup -1390/T/[Ar] cm^3/(molecule s), F/sub cent/ = 0.381e/sup -T/73.2/ + 0.619e/sup -T/1180/, and k/sub infinity/ = 1.50×10^{-7}T/sup 1.18/e/sup -329/T/ cm^3/(molecule s). When used in the Gilbert et al. function, this parametrization produces an excellent representation of the theoretical and experimental rate constants in Ar.

47103 **Interaction of aluminum with the Ru(0001) surface and its influence upon CO chemisorption.** Campbell, C.T.; Goodman, D.W. (Indiana Univ., Bloomington (USA)). *Journal of Physical Chemistry;* **92**: No. 9, 2569-2573(5 May 1988).

The interaction of vapor-deposited Al with the Ru(0001) surface and its influence upon CO chemisorption has been studied in ultrahigh vacuum by use of Auger electron spectroscopy, thermal desorption mass spectroscopy, and low-energy electron diffraction (LEED). Below 670 K, the Al grows as an overlayer in (111) oriented islands. By 1170 K, Al penetrates the surface to form intermetallic compounds with the Ru, and a (root 3 x root 3)R30° LEED pattern dominates the surface structure. This is interpreted in terms of a stoichiometric monolayer of the compound Al_3Ru. Thermal desorption data indicate that this monolayer alloy has a heat of formation of about -24 kcal/mol, compared to -14 kcal/mol for the multilayer alloy which nucleates at higher coverages. The CO/Ru interaction at the surface of these intermetallic compounds is not very different from that on the clean Ru(0001) surface, except for the expected dilution of Ru sites by the added Al. In contrast, when the Al overlayer has not yet been annealed and the Al adatoms still sit on top of the Ru(0001) surface, they have a very strong influence upon CO desorption spectra. A new CO desorption state at 850-1050 K appears at submonolayer Al coverages, which is attributed to strong, direct, interaction between adsorbed CO and Al probably involving C-O bond cleavage.

47104 **Dissociative chemisorption of CO on Ni films promoted by Al: detection of a precursor state to CO dissociation by electron energy loss spectroscopy.** Chen, J.G.; Crowell, J.E.; Ng, L.; Basu, P.; Yates, J.T. Jr. (Univ. of Pittsburgh, PA (USA)). *Journal of Physical Chemistry;* **92**: No. 9, 2574-2579(5 May 1988).

The adsorption and dissociation of CO on Ni-dosed Al(111) surfaces have been investigated in the temperature range of 95-700 K by use of high-resolution electron energy loss spectroscopy (EELS), temperature-programmed desorption (TPD), and Auger electron spectroscopy (AES). A precursor state involving the bonding of both Ni and Al to a CO molecule, most likely a Ni/sub x/-C-O-Al/sub y/ species, is characterized by a vibrational frequency in the range of 1370-1430 cm^{-1}. The interdiffusion process of the Ni/Al layer upon heating gives rise to both desorption and decomposition of the adsorbed CO species.

47105 **Spatial and temporal probe for laser-generated plumes based on density gradients.** Chen, G.; Yeung, E.S. (Iowa State Univ., Ames (USA)). *Analytical Chemistry;* **60**: No. 9, 864-868(1 May 1988). Contract W-7405-ENG-82.

A new universal detector is reported for transient atomization events such as the laser-generated plume. A probe laser beam interrogates the density gradients, which can be monitored as a deflection of the beam in far field. A simple model is used to explain

the observations. Both the shape and the magnitudes of the experimental signals are in good agreement with the predictions. As little as 1 ng of material vaporized off a silicon wafer can be detected. The technique provides insight into the laser vaporization process, because both spatial and temporal information can be derived for individual events.

47105 **Interlaboratory comparison of methane electron capture negative ion mass spectra.** Stemmler, E.A.; Hites, R.A.; Arbogast, V.; Budde, W.L.; Deinzer, M.L.; Dougherty, R.C.; Eichelberger, J.W.; Foltz, R.L.; Grimm, C.; Grimsrud, E.P. (Indiana Univ., Bloomington (USA)). *Analytical Chemistry;* 60: No. 8, 781-787(15 Apr 1988).

The electron capture negative ion (ECNI) mass spectra of 12 compounds were measured on quadrupole and magnetic sector instruments. The compounds were selected as examples of molecules that are often examined by ECNI mass spectrometry. Under similar conditions of sample concentrations and ion source temperatures and pressures, the spectra showed good agreement in the molecular ion mass range. A Hewlett-Packard 5985B quadrupole instrument showed a lower abundance of low mass ions (such as Cl^-) relative to the other instruments. Other sources of spectral variability arose from ion/molecule reactions involving reagent gas impurities and from hydrogen incorporation reactions.

47107 **(N—88-22965) Theoretical and experimental study of the thermophysical properties of lithium hydride.** Shpilrain, E.E.; Yakimovich, K.A.; Kagan, D.N.; Shvalb, V.G. (National Aeronautics and Space Administration, Washington, DC (USA)). Apr 1988. Translation of conference paper presented at the 4th Teplofizicheskie Svoistve Zhidkostei Materialy Vsesoyuznoi Teplofizicheskoi Konferentii, 1971 p 7-13. (NASA-TT—20179; NAS—1.77:20179; CONF-710582—). 11p. NTIS, PC A03/MF A01.

From A theoretical and experimental study of the thermophysical properties of lithium hydride; Odessa, USSR (1 May 1971).

Results of a comprehensive study of LiH in its condensed and vapor phases are given. These studies were carried out at the Institute of High Temperature of the Academy of Sciences of the USSR. The caloric properties of the condensed phase were measured at a temperature interval of 400 to 1400 K by the mixing method using a calorimeter and an evaporating liquid. Results of the four series of experiments, subjected to the least squares method, are approximated by equations.

47108 **Thermodynamics of aqueous borate solutions I. Mixture of boric acid with sodium or potassium borate and chloride.** Simonson, J.M.; Roy, R.N.; Roy, L.N.; Johnson, D.A. (Drury College, Springfield, MO (USA)). *Journal of Solution Chemistry;* 16: No. 10, 791-803(Oct 1987). Contract AC05-84OR21400.

Potentials for the cell without liquid junction H_2, $Pt \setminus B(OH)_3(m_1),MB(OH)_4(m_2),MCl(m_3) \setminus AgCl,Ag$ where M is sodium or potassium are reported over a range of ionic strength to $I = 3$ mol-kg^{-1} at 5 to 55°C. Total boron concentration in the solutions was restricted to low levels to minimize formation of polynuclear boron species. Cell potentials are treated with the Pitzer ion interaction treatment for mixed electrolytes, with linear ionic strength dependence assumed for the activity coefficient of undissociated boric acid. Trace activity coefficients of sodium and potassium borates in chloride media are calculated at various temperatures.

47109 **Dielectric constants of fluid mixtures over a wide range of temperature and density.** Harvey, A.H.; Prausnitz, J.M. (Lawrence Berkeley Lab., CA (USA)). *Journal of Solution Chemistry;* 16: No. 10, 857-869(Oct 1987). Contract AC03-76SF00098.

A new expression is presented for estimating the dielectric constant of a fluid mixture as a function of temperature, density and composition. The estimated dielectric constants (and their derivatives) are required for phase-equilibrium calculations, based on an equation of state, for systems containing electrolytes and nonelectrolytes. The new expression holds for the entire range of fluid densities, from zero to liquid-like densities. Mixing of components is performed on a volume-fraction basis at constant temperature and constant reduced density. For polar components where data are not available at the temperature and/or reduced density of interest, the well-characterized behavior of water is used to extrapolate the available pure-component data. The importance of using the correct density of the mixture is shown. Using one adjustable parameter for each nonideal binary subsystem, predicted results can be significantly improved.

47110 **Acid association quotients of tris(hydroxymethyl)aminomethane in aqueous NaCl media to 200°C.** Palmer, D.A.; Wesolowski, D. (Oak Ridge National Lab., TN (USA)). *Journal of Solution Chemistry;* 16: No. 7, 571-581(Jul 1987). Contract AC05-84OR21400.

The molal acid association quotients of tris(hydroxymethyl)aminomethane (Tris, also abbreviated as THAM) were determined potentiometrically in a concentration cell fitted with hydrogen electrodes. The emf was recorded for equimolal Tris/Tris-HCl buffer solutions from 5 to 200°C at approximately 25° intervals, and at ionic strengths of 0.0759, 0.2012, 0.7232, 1.9996, 3.5077, and 4.9599. The molal association quotients, as well as those selected from the literature and calorimetrically-determined enthalpies of reaction, were simply described by a six parameter equation which yielded the following thermodynamic quantities at infinite dilution and 25°C: $\log K = 8.701 +/- 0.009$, $\Delta H° = -47.53 +/- 0.13$ kJ-mol^{-1}, $\Delta S° = -4.9 +/- 0.5$ J-K^{-1}-mol^{-1}, and $\Delta C°/sub\ p/ = 67 +/- 13$ J-K^{-1}-mol^{-1}. The fitting equation for this isocoulombic reaction incorporates a four term expression for logK and a linear isothermal dependence on ionic strength.

4004 Electrochemistry

REFER ALSO TO CITATION(S) 46705, 47033, 47060, 47108

47111 **(ORNL/TM—10564) Evaluation of alternate construction materials for a lithium electrolysis cell.** Keiser, J.R.; Olsen, A.R.; DiStefano, J.R. (Oak Ridge National Lab., TN (USA)). May 1988. Contract AC05-84OR21400. 39p. NTIS, PC A03/MF A01; 1; GPO Dep. Order Number DE88013500/JAW.

Electrolytic cells currently used for the production of lithium metal are constructed of A285 Grade A steel (carbon content less than 0.15%). Failures of the cell wall have frequently occurred after 2 to 5 years of service, and these failures have been attributed to corrosion resulting from the reaction of iron carbide with lithium. An examination of a recent failure confirmed this conclusion. In an effort to identify alternate construction materials with better corrosion resistance for this application, five materials with very low carbon levels and/or carbides more stable than those in A285 were selected for evaluation. Materials were evaluated after exposure in an operating electrolytic cell, after exposure to pure lithium, and after exposure to a moist air-chlorine mixture. Results show that all five of the alternative materials selected are more corrosion resistant than A285, but two were eliminated from further consideration because of other potential shortcomings. Additional long-term corrosion tests are recommended for the remaining three candidate materials. Final selection should be based on considerations of cost, availability, and fabricability in addition to compatibility. 26 refs., 9 figs., 8 tabs.

47112 **Electrochemistry at anthracene crystal/aqueous NO_3p, NO_3^- solution interface.** Leong, B.; Pope, M.; Steigman, J. (New York Univ., NY (USA)). *Journal of Physical Chemistry;* 92: No. 9, 2506-2511(5 May 1988). Contract AC02-76EV02386.

Holes (radical cations) were injected into one face of an anthracene crystal slab and discharged at the other face, which was in contact with a neutral aqueous solution containing 1 M NO_3^- or NO_3^-. Hole current densities (J) of up to 700 μA cm^{-2} generated a variety of surface oxidation products including anthraquinone, 9-nitroanthracene (9NA), oxanthrone, anthrone, bianthronyl (BA), and 9,10-dinitroanthracene with both NO_3^- and NO_3^- solutions. The amount of BA and 9NA increased as J^2. With increasing NO_3^- concentration the amount of 9NA produced increased, while that of BA decreased. It was concluded that 9NA is made by cooperation of two holes on adjoining molecules at defect sites.

47113 **Charge-transport properties of an electrode-confined redox polymer derived from a monomer consisting of a quinone flanked by two benzylviologen subunits.** Smith, D.K.; Lane, G.A.; Wrighton, M.S. (Massachusetts Institute of Technology, Cambridge (USA)). *Journal of Physical Chemistry;* **92**: No. 9, 2616-2618(5 May 1988).

Electrochemical and optical spectroelectrochemical characterization of an electrode-confined siloxane-based having two benzylviologen subunits flanking a benzoquinone is reported. The polymer, (BV-Q-BV^{0+})/sub n/, is formed by hydrolysis of the -Si(OMe)$_3$ groups of the monomer I, 1,1''-[2,5-dichloro-3,6-dioxo-,1,4-cyclohexadiene-1,4-diyl)bis[imino-2,1-ethanediyl(dimethyliminio)methylene-1,4-phenylenemethylene]]bis[[1'-[[4-)trimethoxysilyl)phenyl]methyl]-4,4'-bipyridinium. Further, electrochemical and optical properties of the solution analogue of I are reported. The (BV-Q-BV^{0+}) unit has two fixed positive charges, one in each of the BV-Q links. The (BV-Q-BV^{0+}) unit is reducible by a $6e^-/2H^+$ process in a manner roughly consistent with the behavior of BV^{2+} ($E^{0'}$(BV/sup 2+/+/) $\approx$ -0.5 V vs SCE; $E^{0'}$(BV/sup +/0/) $\approx$ -0.9 V vs SCE) and Q ($E^{0'}$(Q/QH$_2$) $\approx$ -0.3 V vs SCE at pH 7) studied separately in solution and a siloxane-based polymers confined to electrodes. The important finding is that the (BV-Q-BV^{0+})/sub n/ system shows pH-dependent rectification. The rectification observed is established to be due to a combination of kinetic, thermodynamic, and structural factors all consistent with the conclusion that reduction of all Q centers to QH$_2$ occurs via reducing equivalents delivered through the BV/sup 2+/+/ system and that the reverse process is possible only above a certain pH, $\geq$ 6. The temperature dependence of steady-state transport in (BV-Q-BV^{0+})/sub n/ shows an Arrhenius activation energy of 50-60 kJ/mol.

4005 Photochemistry

REFER ALSO TO CITATION(S) 47402

47114 **Quenching of C_2H emission produced by vacuum ultraviolet photolysis of acetylene.** Sander, R.K.; Tiee, J.J.; Quick, C.R.; Romero, R.J.; Estler, R. (Chemical and Laser Sciences Division, Los Alamos National Laboratory, Los Alamos, New Mexico 87545). *Journal of Chemical Physics;* **89**: No. 6, 3495-3501(15 Sep 1988).

Excited C_2 H* is produced by vacuum ultraviolet photolysis of acetylene using a frequency tripled laser. Time-dependent emission is measured from 400—940 nm. The use of a coherent photolysis source produces an excitation spectrum in which the rotational band contour is resolved. The absorption spectrum of C_2 H_2 taken in the same apparatus closely resembles the excitation spectrum indicating a homogeneous predissociation. Time-dependent quenching of the C_2 H* emission by Xe, Kr, Ar, He, N_2, H_2, D_2, and C_2 H_2 is measured. The rapid quenching rates and lack of strong dependence on atomic weight suggest a spin-allowed process is involved in this channel of C_2 H_2 photolysis. Quench rates are compared with several theoretical models.

47115 **Symmetric stretch excitation of CH_3 in the 193.3 nm photolysis of CH_3I.** Continetti, R.E.; Balko, B.A.; Lee, Y.T. (Materials and Chemical Sciences Division, Lawrence Berkeley Laboratory, and Department of Chemistry, University of California, Berkeley, California 99720). *Journal of Chemical Physics;* **89**: No. 5, 3383-3384(1 Sep 1988).

New high resolution photofragment translational spectroscopy measurements on the 193.3 nm photolysis of CH_3I reveal up to four quanta of ν_1 C—H symmetric stretch excitation in the C—I bond fission channel. In addition these experiments show for the first time that C—H bond fission occurs at wavelengths longer than 185 nm with a quantum yield of ~3%. The data yields upper bounds to the C—H bond dissociation energy in CH_3I of 101 +- 1 kcal/mol and for the C—I bond energy, 55.0 +- 0.3 kcal/mol.

47116 **Triplet-state formation of porphycenes. Intersystem crossing versus sensitization mechanisms.** Levanon, H.; Toporowicz, M.; Ofir, H.; Fessenden, R.W.; Das, P.K.; Vogel, E.; Koecher, M.; Pramod, K. (Univ. of Notre Dame, IN (USA)). *Journal of Physical Chemistry;* **92**: No. 9, 2429-2433(5 May 1988).

The authors report on a study of the photoexcited triplet state, in the liquid phase, of the following free-base porphycenes: parent porphycene (H_2PCl), 2,7,12,17-tetra-n-propylporphycene (H_2PC2), and 9,10,19,20-tetra-n-propylporphycene (H_2PC3). The triplet states are produced by two independent experimental methods: (i) singlet-triplet intersystem crossing following laser excitation; (ii) triplet-triplet sensitization, following pulse radiolysis of the same solutions as in (i) and the sensitizer, β-acetonaphthone. The latter method produces comparable yields of the photoexcited triplet, at room temperature, independent of the substitution site, whereas in the former method, the triplet yield of H_2PC3 is negligible at room temperature. The triplet-triplet absorption of the alkyl-substituted free-base porphycene, H_2PC3/sup T/, starts to show a reasonable signal-to-noise ratio only at temperatures below ~ 240 K. This temperature dependence is interpreted in terms of a thermally activated excited state in the singlet manifold, ~ 1000 cm^{-1} above S_1. Supporting evidence for such a mechanism is provided by the similarity of the temperature dependence of the triplet-triplet absorption and fluorescence intensity of H_2PC3.

47117 **Kinetics of electron transfer from photoexcited superlattice electrodes.** Nozik, A.J.; Turner, J.A.; Peterson, M.W. (Solar Energy Research Institute, Golden, CO (USA)). *Journal of Physical Chemistry;* **92**: No. 9, 2493-2501(5 May 1988).

A kinetic model has been developed that quantitatively describes electron transfer from photoexcited superlattice electrodes into liquid solutions. The model permits electron transfer from all quantum levels as well as from surface states; it also takes into account recombination in the bulk, space charge layer, and surfaces states, and band-edge movement. The model calculations define the values of the rate constants for heterogeneous electron transfer and hot electron thermalization among the various energy levels in the supperlattice quantum wells that are necessary to achieve hot electron transfer from excited quantum states. The question of whether hot electron transfer is manifested by a dependence of the photocurrent action spectra on acceptor redox potential is examined in detail.

47118 **Computer simulations of photochemical water cleavage systems. 2. Effects of particle size and ion concentration on the production of hydrogen from water mediated with a colloidal catalyst.** Lenoir, P.M.; Sassoon, R.E.; Kozak, J.J. (Univ. of Notre Dame, IN (USA)). *Journal of Physical Chemistry;* **92**: No. 9, 2526-2536(5 May 1988).

An in-depth analysis of the reactions of the reduced radical cation of methylviologen (MV/sup .+/ with a colloidal platinum catalyst (Pt/sub c/) has been performed using the authors computer simulation technique. Rate equations, containing both diffusion- and activation-controlled components, were derived for the individual stages of their reaction scheme. The electrostatic effect due to the charge carried by all the adsorbed species on the particle were treated by an approximate solution of the Poisson-Boltzmann equation for a charge sphere and the results incorporated into the value of the diffusion-controlled component of the rate constant. Optimization of the activation-controlled components was achieved by carrying out numerous computer simulations on the reaction system until good agreement was found with experimental results for the behavior of the MV/sup .+/ concentration profiles with time over the pH range 1-11. The significance of the values of the rate constants is discussed by considering the effects on the behavior of the overall reaction system realized by decreasing their values. Predictions are made concerning the dependence of the overall reaction rates on catalyst particle size in the range of radii from 15 to 100 A. A decrease in the rate of reaction on increasing the size of particle is generally observed and is attributed to a corresponding reduction in the total number of accessible reactive surface sites at constant Pt atom concentration. The variation of order with respect to platinum as a function of size and pH was also investigated by using their present treatment and a thorough analysis of the behavior of the system again revealed the importance of fractional coverage terms in explaining the behavior. Moreover, it was found that the order with respect to [Pt] also depends on whether the rate-controlling steps in the system are diffusion- or activation-controlled.

47119 **Photoionization of N,N,N',N'-tetramethylbenzidine in anionic-cationic mixed micelles of sodium dodecyl sulfate-dodecyltrimethylammonium chloride: electron spin resonance and electron spin echo modulation studies.** Rivara-Minten, E.; Baglioni, P.; Kevan, L. (Univ. of Houston, TX (USA)). *Journal of Physical Chemistry;* **92**: No. 9, 2613-2615(5 May 1988).

Electron spin echo modulation (ESEM) and electron spin resonance (ESR) spectra of the photogenerated N,N,N',N'-tetramethylbenzidine cation radical (TMB^+) in frozen mixed micelles of dodecyltrimethylammonium chloride (DTAC) and sodium dodecyl sulfate (SDS) have been studied as a function of the mixed micelle composition. ESEM effects due to TMB^+ interactions with deuterium in D_2O show a decrease of the TMB^+-water interaction that depends on the SDS-DTAC mixed micelle composition and reaches a minimum for the equimolar mixed micelle. The efficiency of charge separation upon photoionization of TMB to produce TMB^+ measured by ESR correlates with the degree of water penetration into the micelle. ESEM effects due to interaction of x-doxylstearic acid nitroxide probes with deuterium in D_2O show that the decrease of water penetration is due to higher surface packing due to electrostatic attraction among the polar headgroups of the two surfactants.

4006 Radiation Chemistry

REFER ALSO TO CITATION(S) 46883, 46884, 46885, 47116, 47372

47120 (INIS-BR—1164, pp 23) **Characterization and formation of free radicals in the 2,2,6,6 tetramethyl-4-piperodoni, using the EPR and x-ray techniques.** Koury, E.F.; Tabak, M.; Nascimento, O.R. (Sao Paulo Univ., Sao Carlos, SP (Brazil). Inst. de Fisica e Quimica). 1987. (In Portuguese). NTIS (US Sales Only), PC A09/MF A01. Order Number DE88703566/JAW. (CONF-8705181—).

From 10. national meeting on condensed matter physics; Caxambu, Brazil (5 May 1987).

47121 **(RISO-M—2693) Accelerator Department. Annual progress report. 1 January-31 December 1987.** (Risoe National Lab., Roskilde (Denmark)). Mar 1988. 36p. NTIS (US Sales Only), PC A03/MF A01. Order Number DE88753659/JAW.

A description is given of research in the fields of chemical reactivity, radiation physics, physical dosimetry and technological application of radiation and irradiation technology, as well as of the operation of various irradiation facilities.

47122 **Electron-stimulated desorption of O^+ ions from a gas-covered CdS(0001) surface.** Ekwelundu, E.C.; Ignatiev, A. (Department of Physics, University of Houston, University Park, Houston, Texas 77004). *Physical Review [Section] B: Condensed Matter;* **38**: No. 6, 3671-3675(15 Aug 1988).

Electron-stimulated desorption of O^+ ions from a CdS(0001) single-crystal surface exposed to O_2 and NO has been investigated. Only O^+ desorption was observed in both cases with a total cross section of ~10/sup -17/ cm^2. The dependence of the ion yield on the incident electron-beam energy from 0—180 eV exhibits threshholds at both the Cd 4d, 4p, 4s, and the S 3s and 2p core-level binding energies. Evidence is presented which indicates that the ions may originate from multiple states.

47123 **Spectrum integrated (n,He) cross section comparison and least squares analysis for /sup 6/Li and /sup 10/B in benchmark fields.** Schenter, R.E.; Oliver, B.M.; Farrar, H. IV. (Westinghouse Hanford Co., P.O. Box 1970, Richland, WA (US)). pp 781-788 of Influence of radiation on material properties: ASTM 13th international symposium (Part II). Garner, F.A.; Henager, C.H.; Igata, N. Philadelphia, PA; ASTM (1987). (CONF-860605—).

From 13. international symposium on the effects of radiation on materials; Seattle, WA, USA (23 Jun 1986).

Spectrum integrated cross sections for /sup 6/Li and /sup 10/B from five benchmark fast reactor neutron fields are compared with calculated values obtained using the ENDF/B-V Cross Section Files. The benchmark fields include the Coupled Fast Reactivity Measurements Facility (CFRMF) at the Idaho National Engineering Laboratory, the 10% Enriched U-235 Critical Assembly (BIG-10) at Los Alamos National Laboratory, the Sigma Sigma and Fission Cavity fields of the BR-1 reactor at CEN/SCK, and the Intermediate-Energy Standard Neutron Field (ISNF) at the National Bureau of Standards. Results from least square analyses using the FERRET computer code to obtain adjusted cross section values and their uncertainties are presented. Input to these calculations include the above five benchmark data sets. These analyses indicate a need for revision in the ENDF/B-V files for the /sup 10/B cross section for energies above 50 keV.

4007 Radiochemistry And Nuclear Chemistry

REFER ALSO TO CITATION(S) 46381, 46640, 47087

47124 **(INIS-mf—11731) Solubility of technetium dioxide in water and in concentrated salt solution.** Bauscher, C.; Lieser, K.H. (Technische Univ. Darmstadt (Germany, F.R.). Lehrstuhl fuer Kernchemie; Bundesministerium fuer Forschung und Technologie, Bonn (Germany, F.R.)). [1987]. 39p. (In German). NTIS (US Sales Only), PC A03/MF A01. Order Number DE88754592/JAW.

Technetium dioxide was obtained by thermal decomposition of NH/sub 4/TcO/sub 4/ and characterised in terms of crystal structure, grain size distribution and specific surface area. The dissolution experiments were made with 0.1 M NaNO/sub 3/ solution, saturated NaCl solution, and quinary solution, applying the shaking technique, and the results were evaluated as a function of shaking period, TcO/sub 2/ amount fed in, pH-value, temperature, and oxygen content. The dissolved Tc thus obtained was by more than 99% TcO/sub 4//sup -/ in the solution. The oxygen content in the solution considerably determines the dissolution rate. Various pH-values result in the formation of different complexes in the various solutions and thus lead to different dissolution rates. The dissolution rate of TcO/sub 2/ in saturated NaCl solution is three times higher under aerobic conditions than in 0.1 M NaNO/sub 3/ solution, and in quinary solution it is two times higher.

47125 **(IYF-R—10-297) State and occurrence forms of radionuclides in liquid radioactive wastes.** Vdovina, E.D.; Radyuk, R.I. (AN Uzbekskoj SSR, Tashkent. Inst. Yadernoj Fiziki). 1987. 7p. (In Russian). NTIS (US Sales Only), PC A02/MF A01. Order Number DE88703647/JAW.

The investigation results of Co (2)-microquantity states in solutions at pH 1.0-11.0 are given. It has been shown that the probability of pseudo-colloid formation is small, and that Co (2) ions are in solution as soluble forms having positive charges. 14 refs.; 2 figs.;.

47126 **(MLM—3519(OP)) NMR [Nuclear Magnetic Resonance] studies of aging effects in palladium tritide.** Abell, G.C.; Attalla, A. (Monsanto Research Corp., Miamisburg, OH (USA). Mound). 1988. Contract AC04-76DP00053. 6p. (CONF-880505—30). NTIS, PC A02. Order Number DE88012872/JAW.

From 3. topical meeting on tritium technology in fission, fusion and isotopic applications; Toronto, Canada (1 May 1988).

This paper presents Nuclear Magnetic Resonance (NMR) studies of aging phenomena in palladium tritide. ^3He NMR relaxation parameters have been measured as a function of temperature for 6-, 13-, and 22-month-old beta phase palladium tritide. The most significant result of this study is the observation of a solid/fluid phase transition near 250{degree}K of ^3He that has accumulated in the PdT/sub x/ substrate via triton decay. Although the existence of solid helium at relatively high temperatures had been predicted for helium in metals, it had not previously been confirmed in any metal/helium system. The observed melting temperatures, together with the known equation of state for ^4He, allow a determination of the helium density as a function of age. The atomic density obtained in this way is approximately 2.0 times that of palladium metal, agreeing with densities inferred from dilatometric measurements of other metal tritides and also with predictions based on the concept of dislocation loop punching by highly overpressurized He

bubbles. The ^3He signal in the 22-month-old sample was sufficiently strong to allow a detailed study of melting as a function of temperature, and provides information on the distribution of densities over the ensemble of bubbles.

47127 Plutonium-238 production at the Savannah River Plant. Roggenkamp, P.L. (Savannah River Plant, Aiken, SC (USA)). *Transactions of the American Nuclear Society;* **55**: 239(1987). (CONF-8711195—).

From American Nuclear Society winter meeting; Los Angeles, CA, USA (15 Nov 1987).

Capability exists at the Savannah River Plant (SRP) for the US Dept. of Energy to produce ~ 50 kg of ^{238}Pu annually for use as the source of heat for radioisotope-powered electric generators. The factor that limits the ^{238}Pu production is the availability of ^{237}Np, which is the target nuclide in which neutrons are captured to produce ^{238}Pu by the subsequent decay of the ^{238}Np neutron capture product. Capacities of processing facilities at SRP match the 50 kg/yr with varying margins up to 50%. The SRP reactors are ideal reactors for isotope production. The heavy-water moderator provides excellent neutron economy. Reactor fuel is highly enriched uranium contained in tubular elements, which are separate from the target elements whether the product be ^{238}Pu, ^{239}Pu, tritium, or other nuclide species. The use of fuel and target elements that are separate generally simplifies the isotope recovery process. Over type years, a great simplifies the isotope recovery produced. The current inventory of ^{237}Np is ~ 400 kg, which with the annual production rate of ^{237}Np of ~ 80 kg, will sustain an annual ^{238}Pu production rate of ~ 50 kg. The unit cost of the ^{238}Pu is approximately #1200/g for manufacture and approximately $400/g for heat source fabrication exclusive of the cost of the iridium shell material.

47128 Recovery of noble metals from HLLW using photocatalytic reduction. Nishi, T.; Uetake, N.; Kawamura, F.; Yusa, H. *Transactions of the American Nuclear Society;* **55**: 242-243(1987). (CONF-8711195—).

From American Nuclear Society winter meeting; Los Angeles, CA, USA (15 Nov 1987).

In high-level liquid waste (HLLW) from fuel reprocessing plants, noble metals (palladium, rhodium, and ruthenium), which account for ~ 10 wt% of fission products, exist as ions. These metals are very useful as catalytic material in automobile exhaust systems and other chemical processes, but they are rare in nature, making their recovery from fission products highly desirable. The ions of noble metals in solution have the feature that their reduction potential from ion to metal is relatively high compared with that of other fission product ions, so they can be selectively separated as a metal by a reduction process. The authors think a photoreduction process using a photocatalysts, which functions as photon-electron conversion agent, is suitable for the recovery of noble metals from HLLW for three reasons: (1) this process uses no reduction agents, which usually degrade the nitric acid, so that coprecipitation of other fission products does not occur. (2) The reactions are induced by light, which does not contaminate the reaction system, and in contrast with ordinary photo-redox reactions, the quantum yield is quite high. (3) As the photocatalyst does not change in the reaction, it can be used again and again. The report shows the results of fundamental experiments on the application of photocatalytic reduction to the recovery of noble metal ions in nitric acid solution.

4008 Combustion, Pyrolysis, And High-temperature Chemistry

REFER ALSO TO CITATION(S) 46754, 46905, 47074, 47874

47129 (CONF-8708178—3) Research needs in high temperature chemistry. Mesmer, R.E. (Oak Ridge National Lab., TN (USA)). 1987. Contract AC05-84OR21400. 4p. NTIS, PC A02/MF A01; 1; GPO Dep. Order Number TI88012929/JAW.

From Temperature aqueous solutions; Provo, UT, USA (25 Aug 1987).

Remarkable progress has been made in the last decade or so in the development of a data base on the thermodynamics and chemical properties of aqueous systems at high temperatures and pressures. Many of the conventional physical chemical methods have been adapted for use at high temperatures and pressures and recently some of the more significant ones of those have been the flow methods. A review of basic research needs in aqueous chemistry at high temperatures is presented.

47130 (INPE—4516-RPE/564) Combustion of a double base fuel in the presence of inert gases. Fachinifilho, F.; Seraphicodesouzamigueis, C.E.; Gill, W.; Bastosnetto, D. (Instituto de Pesquisas Espaciais, Sao Jose dos Campos (Brazil)). May 1988. 16p. (In several languages). NTIS, PC A03/MF A01.

Solid propellant rocket engines are simple and reliable; however, they have the disadvantage of permitting only directional control of the thrust. This work is a continuation of an ongoing effort to understand the mechanism of thrust level modulation using inert gas injection into the combustion chamber. Here, tests are done using combustion bombs, analyzing the effect of the presence of inert gases on the burning of a double base fuel.

47131 (LBL—24687) The importance of thermodynamics to the modeling of nitrogen combustion chemistry. Martin, R.J.; Brown, N.J. (Lawrence Berkeley Lab., CA (USA)). Jul 1988. Contract AC03-76SF00098. 32p. (CONF-880802—9). NTIS, PC A03/MF A01; 1; GPO Dep. Order Number DE88014656/JAW.

From 22. international symposium on combustion; Seattle, WA, USA (14 Aug 1988).

Modeling calculations have been performed to illustrate the effect of using five commonly accepted data bases of thermochemical properties on predictions of temporal species profiles. The thermochemical properties are those used for the determination of equilibrium constants employed in the calculation of reverse rate coefficients for a chemical mechanism where forward rate coefficients are specified. The modeling study was performed for hydrogen/oxygen/argon/nitrogen-compound mixtures where the nitrogen compound was either NO or NH_3. The mixtures reacted isothermally at 1600 K and isobarically at 1 atmosphere, and a single kinetic mechanism for which forward rate coefficients were specified was used throughout. Mixtures of equivalence ratios of 0. 625, 1.0 and 1.6 were considered. Modifications in sources of thermodynamic data have been substantial since 1971 for some species. Among the data bases, thermochemical properties varied greatly for the species NH, NH_3, NNH, and HO_2, and those for other species important in the mechanism had variations of less than 10 percent. The thermochemical property variations among the data bases in NH, NH_3 and NNH have substantial effects upon the temporal species profiles for nitrogenous species. While this result is not surprising, unfortunately, it is often overlooked when modeling results are compared. This effect is most pronounced for rich combustion, and varies directly with equivalence ratio. Use of different data bases had little effect on the H/O species profiles. Radical species profiles (with the exception of HO_2) tend to be influenced strongly by their own thermochemical properties. Computed profiles also were shown to be independent of algorithm (HCT or CHEMKIN) and thermodynamic property fitting procedure between 1000 and 2000{degree}K. 24 refs., 3 tabs.

47132 (LBL—25230) Reaction rates in premixed turbulent flames and their relevance to the turbulent burning speed. Cheng, R.K.; Shepherd, I.G.; Talbot, L. (Lawrence Berkeley Lab., CA (USA)). Dec 1987. Contract AC03-76SF00098. 21p. (CONF-880802—8). NTIS, PC A03/MF A01; 1; GPO Dep. Order Number DE88012021/JAW.

From 22. international symposium on combustion; Seattle, WA, USA (14 Aug 1988).

An experimental procedure to measure the local reaction rate, {bar char}w, in premixed turbulent flames is presented. It utilizes the flame crossing frequency sub-model for the reaction rate formulated by Bray-Champion-Libby (BCL) for turbulent flames with unstrained or equally strained flamelets. The experiments involve measuring the flame crossing frequencies and the conditioned mean velocity of two components using respectively Mie scattering and two color LDA techniques. A method of analysis has also been developed to deduce the turbulent burning speed from {bar char}w. The turbulent/laminar burning speed ratio is obtained by

integrating the reaction rates measured along 2D mean Lagrangian flowlines through the flame brush. The flowlines are traced automatically using feedback control for positioning the LDA probe. The method has been applied to study five v-flames and four large Bunsen type conical flames. The distributions of {bar char}w are well predicted by the BCL model. The turbulent flame speed results based on {bar char}w are in excellent agreement with those obtained by the conventional flame orientation method. The main advantage of using this method to determine the turbulent burning speed is that the uncertainties are lowered. Furthermore, it can be applied successfully to flames with complex geometries such as the flame tip region of a conical flame. 22 refs., 5 figs., 2 tabs.

47133 **(MLM—3491(OP)) High-speed photography of energetic materials and components with a copper vapor laser.** Dosser, L.R.; Reed, J.W.; Stark, M.A. (Monsanto Research Corp., Miamisburg, OH (USA). Mound). 1988. Contract AC04-76DP00053. 6p. (CONF-880408—32). NTIS, PC A02/MF A01; 1; GPO Dep. Order Number DE88012869/JAW.

From Spring meeting of the Materials Research Society; Reno, NV, USA (4 Apr 1988).

The evaluation of the properties of energetic materials, such as burn rate and ignition energy, is of primary importance in understanding their reactions and the functioning of devices containing them. One method for recording such information is high-speed photography at rates of up to 20,000 images per second. When a copper vapor laser is synchronized with the camera, laser-illuminated images can be recorded that detail the performance of a material and/or component in a manner never before possible. The laser can also be used for ignition of the energetic material, thus eliminating the need for bridgewires or electric squibs that can interfere with photography. Details of such ignitions are readily observable, and the burn rate of a material can be determined directly from the film. There are indications that information useful for the modeling of pyrotechnic reactions will become available as well. Recent results from high-speed photography of several pyrotechnic materials and devices will be presented. 9 figs.

47134 **(MLM—3498(OP)) Laser illuminated high speed photography of energetic materials.** Dosser, L.R.; Reed, J.W.; Stark, M.A. (Monsanto Research Corp., Miamisburg, OH (USA). Mound). 1988. Contract AC04-76DP00053. 5p. (CONF-8804159—2). NTIS, PC A02/MF A01; 1; GPO Dep. Order Number DE88012870/JAW.

From Medical and material processing applications of various types of lasers; Cincinnati, OH, USA (21 Apr 1988).

The evaluation of the properties of energetic materials, such as burn rate and ignition, is of primary importance in understanding their reactions and how devices containing them perform their function. We have recently applied high speed photography at rates of up to 20,000 images per second to this problem. When a copper vapor laser is synchronized to the high speed camera, laser illuminated images can be recorded that detail the performance of a component in a manner never before possible. The copper vapor laser used for these experiments had an average power of 30 watts, and produced pulses at a rate of up to 10 kHz. The 30 nanosecond pulsewidth of the laser essentially freezes all motion in the functioning componment, thus providing stop-action pictures at a rate of up to 10,000 per second. Each laser pulse has a peak power of approximately 170,000 watts which provides ample illumination for the high speed photography. Several energetic materials and components studied include the pyrotechnic Ti/2B, a pyrotechnic torch, laser ignition of high explosives, and a functioning igniter.

47135 (N—88-23086, pp vp) **Premixed turbulent flame calculation.** El-Tahry, S.; Rutland, C.J.; Ferziger, J.H.; Rogers, M.M. (Stanford Univ., CA (USA)). Dec 1987. NTIS, PC A14/MF A01. (NASA-CR—182692; NAS—1.26:182692; SU—CTR-S87; CONF-8707190—).

From Summer program on studying turbulence using numerical simulation databases; Stanford, CA, USA (13 Jul 1987).

The importance of turbulent premixed flames in a variety of applications has led to a substantial amount of effort towards improving the understanding of these flames. Although these efforts have increased the understanding, many questions still remain. The use of direct numerical simulation (DNS) in solving these questions is examined.

47136 **(NBSIR—88-3767) Products of wood smolder and their relation to wood-burning stoves.** Ohlemiller, T.; Shaub, W. (National Bureau of Standards, Washington, DC (USA). Center for Fire Research). May 1988. Contract AI01-76PR06010. 90p. NTIS, PC A05/MF A01; 1; GPO Dep. Order Number DE88012822/JAW.

The smoldering combustion of solid wood is a process pertinent to both fire safety and to the generation of air pollutants in wood burning stoves; fundamental aspects of this process are examined here in order to provide insights into both of these problem areas. The wood configuration employed here was designed to permit self-sustained smolder with visual access. Tests were conducted with both red oak and white pine and both woods behaved quite similarly. In separate tests the air flow velocity was varied from about 9 to 22 cm/sec. At the low end of this range, the smoldering process was prone to extinction; at the high end it was increasingly likely to transition into flaming combustion. The smolder velocity, peak temperature, rate of heat and product evolution all increased over this flow range in an essentially linear manner. Analysis of the temperature profiles in the wood pointed to a dominance of radiative transfer in the smolder propagation process at low air flow rates and roughly equal roles for radiation and convection at higher flow rates. The principal species in the tar evolved from smoldering wood resemble, in large degree, those from previous forced wood gasification experiments and those obtained from a wood stove operated in a smoldering mode. This reinforces the previous conclusion that air pollutants arise directly from wood smolder and change little in passing through the firebox of a stove. 36 refs., 27 figs., 2 tabs.

47137 **(UCRL—99056) Fluid mechanical properties of flames in enclosures.** Rotman, D.A.; Pindera, M.Z.; Oppenheim, A.K. (Lawrence Livermore National Lab., CA (USA); California Univ., Berkeley (USA)). Jul 1988. Contract W-7405-ENG-48;AC03-76SF00098. 17p. (CONF-880889—1). NTIS, PC A03/MF A01; 1; GPO Dep. Order Number DE88014142/JAW.

From 11. international colloquium on dynamics of explosions and reactive systems; Warsaw, Poland (2 Aug 1988).

In an enclosure where the reacting medium is initially at rest, the flame first generates a flowfield that then gets stretched, i.e., its front is pulled along the surface by the flowfield in which it then finds itself residing. A methodology developed for numerical modeling of such fields is described. Of key significance in this respect is the zero Mach number model{endash}a reasonable idealization in view of the relatively high temperature, and hence sound speed, that exists, concomitantly with a comparatively low particle velocity, in the confinement of a combustion chamber. According to this model, the density gradient in the field is nullified, while across the flame front it approaches infinity. One has thus two regimes: one of the unburned medium and the other of the burned gas, each of spatially uniform density, separated by a flame front interface. The latter is endowed with four properties, of which the first two are purely kinematic and the others dynamic in nature, namely: 1) it is advected at the local velocity of flow; 2) it self-advances at the normal burning speed, the eigenvalue of the system; 3) it acts as the velocity source due to the exothermicity of the combustion process; and 4) it acts as the vorticity source due to the baroclinic effect generated by the pressure gradient along its surface and the density gradient across it. A solution obtained for a flame propagating in an oblong rectangular enclosure demonstrates that the latter has a significant influence upon the formation of the well known tulip shape. 12 refs., 4 figs.

47138 **Formation of H and D atoms in pyrolysis of benzene-d_6, chlorobenzene, bromobenzene, and iodobenzene behind shock waves.** Rao, V.S.; Skinner, G.B. (Wright State Univ., Dayton, OH (USA)). *Journal of Physical Chemistry;* 92: No. 9, 2442-2448(5 May 1988). Contract AC02-76ER02944.

Highly dilute mixtures of benzene-d_6, chlorobenzene, bromobenzene (including the 4-d and 2,4,6-d_3 isotopic compounds and iodobenzene in argon were pyrolyzed behind incident shock waves

with a total pressure of 0.4 atm and temperatures between 1450 and 1900 K. H and D atom concentrations were measured, both of them for the partially deuteriated bromobenzenes. Rate constants for dissociation of benzene and of the phenyl radical were determined, but attempts to deduce the specific mechanism or mechanisms of phenyl radical dissociation from the product distributions from partially deuteriated bromobenzenes were unsuccessful. RRKM calculations were made to evaluate unimolecular falloff and to evaluate the rate constant for dissociation of C_6H_6 from that of C_6D_6.

47139 **Theoretical modeling of the fluid mechanics and gas-phase chemistry in a rotating-disk chemical vapor deposition reactor.** Coltrin, M.; Kee, R.; Evans, G.; Miller, J. (Sandia National Labs., Albuquerque, NM (US)). pp 33-41 of Proceedings of the tenth international conference on chemical vapor deposition, 1987. Cullen, G.W. Pennington, NJ; The Electrochemical Society (1987). (CONF-8710183—).

From 10. international conference on chemical vapor deposition; Honolulu, HI, USA (1 Oct 1987).

The authors describe a mathematical model of the coupled fluid mechanics and gas-phase chemical kinetics in a rotating-disk chemical vapor deposition reactor. The analysis uses a similarity transformation that reduces the problem to a one-dimensional boundary value problem. The deposition of silicon from silane is used as an example system. They present predictions of deposition rate as a function of susceptor temperature, spin rate, and carrier gas.

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47140 **(N—88-23226) Lewis structures technology, 1988. Volume 1: structural dynamics.** (National Aeronautics and Space Administration, Cleveland, OH (USA). Lewis Research Center). May 1988. vp. (NASA-CP—3003-VOL-1; E—3970-VOL-1; NAS—1.55:3003-VOL-1; CONF-8805178—). NTIS, PC A20/MF A01.

From Lewis structures technology symposium; Cleveland, OH, USA (24 May 1988).

The specific purpose of the symposium was to familiarize the engineering structures community with the depth and range of research performed by the Structures Division of the Lewis Research Center and its academic and industrial partners. Sessions covered vibration control, fracture mechanics, ceramic component reliability, parallel computing, nondestructive testing, dynamical systems, fatigue and damage, wind turbines, hot section technology, structural mechanics codes, computational methods for dynamics, structural optimization, and applications of structural dynamics.

47141 **(WHC-SA—0176-FP) What is a design engineer?.** Thomson, J.D.; Morris, K.L. (Westinghouse Hanford Co., Richland, WA (USA)). Nov 1987. Contract AC06-87RL10930. 24p. NTIS, PC A03/MF A01; 1; GPO Dep. Order Number DE88013669/JAW.

The poles and task of a design engineer are outlined. An actual engineering design project, a surveillance and in-service inspection robot, is used to illustrate these tasks. (DWL)

4202 Facilities And Equipment

REFER ALSO TO CITATION(S) 46272, 46375, 46384, 46394, 46512, 46531, 46828, 46965, 47304, 47360, 47454, 47959

47142 **(CONF-880887—8) Design of high-reflectivity supermirror structures.** Hater, J.B.; Mook, H.A. (Oak Ridge National Lab., TN (USA)). 1988. Contract AC05-84OR21400. 9p. NTIS, PC A02/MF A01; 1; GPO Dep. Order Number DE88015287/JAW.

From 32. international technical symposium on optical and opto-electronic applied sciences and engineering; San Diego, CA, USA (14 Aug 1988).

We present a new method of designing supermirrors, based on considering the contribution of each bilayer to the extinction in a given stack of bilayers, and derive and solve the discrete equations governing the choice of layer thicknesses. In the limit of zero layer thickness, the usual continuum result is recovered. The design, which can produce essentially perfect reflectivity over the entire supermirror range, also provides an objective physical mechanism for trading reflectivity to gain angular range. 17 refs., 3 figs.

47143 **(DOE/CE/15334—T3) Non-contacting fluid ring seal systems for railcar axle bearing systems: Quarterly progress report No. 4, March 16-June 15, 1988.** (Ernst Mechanical Industries, Old Saybrook, CT (USA)). Jun 1988. Contract FG01-87CE15334. 11p. NTIS, PC A03/MF A01; 1; GPO Dep. Order Number DE88012703/JAW.

The main objectives of this DOE contract is the technical development of a practical, cost effective Fluid Ring seal system capable of: Drastically reducing locomotive drawbar traction power requirements by lowering seal friction losses prevalent in present railcar axle bearing systems; increasing reliability and safety of railroad cars by minimizing bearing lubricant leakage and minimizing bearing "hot boxes"; and improving the productivity of the railway transportation systems by reducing rolling stock "outages" due to long seal life. Listed in this report are the seal test data.

47144 **(DTH-DCAMM—362) Efficient method for analyzing pipe networks.** Bruun Nielsen, H. (Danmarks Tekniske Hoejskole, Lyngby. Numerisk Inst.). Nov 1987. 26p. NTIS (US Sales Only), PC A03/MF A01. Order Number DE88754066/JAW.

The governing equations for a general network are first set up, and then reformulated in terms of matrices. This is exploited to show that the choice of model for the flow equations are essential for the behaviour of the iterative method used to solve the problem: If the flow equations are formulated in terms of pipe discharges, then the energy heads can be eliminated, and we get a set of generalised loop equations; further, an iterative method as Newton-Raphson's method gives identical discharge-iteratives when applied to the full system or to the reduced system. Similarly, when the flow equations are expressed in terms of energy heads, then Newton-iterations gives identical iterates for energy heads when applied to the full or to reduced system. The behaviour of some iterative methods is compared in the initial phase with large errors. It is concluded that it is best to use the generalized loopequations, and a robust iterative strategy is suggested.

47145 **(INIS-BR—1164, pp 100) Optimization of Nb/sub 3/Sn superconducting cables obtained by the liquid diffusion method.** Rodrigues Junior, D.; Pinatti, D.G. (Universidade Estadual de Campinas (Brazil). Inst. de Fisica). 1987. (In Portuguese). NTIS (US Sales Only), PC A09/MF A01. Order Number DE88703566/JAW. (CONF-8705181—).

From 10. national meeting on condensed matter physics; Caxambu, Brazil (5 May 1987).

47146 **(INIS-mf—11753) Investigation and determination of safety and health physics specifications for packaging and conditioning of decommissioning wastes.** Rittscher, D.; Geiser, H.; Kloeckner, F. (Gesellschaft fuer Nuklearservice, Essen (Germany, F.R.); Bundesministerium fuer Forschung und Technologie, Bonn (Germany, F.R.)). Sep 1987. 157p. (In German). NTIS (US Sales Only), PC A08/MF A01. Order Number DE88754595/JAW.

This report analyzed the impact of the new IAEA recommendations on future transports of radioactive materials in waste containers intended for final storage in the KONRAD facility. Through the application of the new transport regulations to the KONRAD containers, the major portion of the transports can be made in standardized industrial packaging. The transition area for the use of Type B casks was described. Also, safety and health physics aspects were examined by computer and/or by experiment. For this, loading and conditioning experiments were performed with full-scale standardized Type V containers. The loading of containers was tested with steel scrap, rubble and bulky materials in drums. The feasibility of filling in the hollow spaces in containers, even with loose rubble, was demonstrated. For this purpose, filler material with special flow characteristics was selected and tested. Post-test examinations of the containers showed that the hollow

spaces had been practically completely filled in the tests. The health physics aspects of the large-scale packaging of radioactive waste from decommissioning were considered, and tips for the future application of this technique were given.

47147 **(JINR—R-8-87-604) Cryogenic thermometers based on TVO type resistors and their application.** Datskov, V.I.; Petrova, L.V.; Tsvineva, G.P. (Joint Inst. for Nuclear Research, Dubna (USSR). Lab. of High Energy). 1987. 12p. (In Russian). NTIS (US Sales Only), PC A03/MF A01. Order Number DE88703755/JAW.

Results of a study of the characteristics of cryogenic thermometers based on TVO-0.125 resistors (R/sub H/=1 kΩ) are presented. At a temperature of 4.2 K the repetition of values during 7 years is no worse than 0.015 K (~ 0.4%), the sensitivity of some samples is from 570 Ω/K to 1600 Ω/K, the error in a magnetic field of 6 T is > 1%, the error after the π-radiation by 10/sup 17/ n/cm/sup 2/ fast neutrons is < 1%, the heat capacity is ~ 1x3x10/sup -4/ J/g.K, and the thermal inertia is ~ 1 ms. Some interpolation formulae are presented. Recomendations on the application of the cryogenic thermometers in setups are given. 12 refs.; 14 figs.; 2 tabs.

47148 **(N—88-22438) Thermal stress in high temperature cylindrical fasteners.** Blosser, M.L. (National Aeronautics and Space Administration, Hampton, VA (USA). Langley Research Center). May 1988. 13p. (NASA-TM—100611; NAS—1.15:100611; CONF-880483—). NTIS, PC A03/MF A01.

From 29. structures dynamics and materials conference; Williamsburg, VA, USA (18 Apr 1988).

Uninsulated structures fabricated from carbon or silicon-based materials, which are allowed to become hot during flight, are attractive for the design of some components of hypersonic vehicles. They have the potential to reduce weight and increase vehicle efficiency. Because of manufacturing contraints, these structures will consist of parts which must be fastened together. The thermal expansion mismatch between conventional metal fasteners and carbon or silicon-based structural materials may make it difficult to design a structural joint which is tight over the operational temperature range without exceeding allowable stress limits. In this study, algebraic, closed-form solutions for calculating the thermal stresses resulting from radial thermal expansion mismatch around a cylindrical fastener are developed. These solutions permit a designer to quickly evaluate many combinations of materials for the fastener and the structure. Using the algebraic equations developed, material properties and joint geometry were varied to determine their effect on thermal stresses. Finite element analyses were used to verify that the closed-form solutions derived give the correct thermal stress distribution around a cylindrical fastener and to investigate the effect of some of the simplifying assumptions made in developing the closed-form solutions for thermal stresses.

47149 (N—88-23226, pp vp) **Electromagnetic dampers for cryogenic applications.** Brown, G.V.; Dirusso, E. May 1988. NTIS, PC A20/MF A01. (NASA-CP—3003-VOL-1; E—3970-VOL-1; NAS—1.55:3003-VOL-1; CONF-8805178—).

From Lewis structures technology symposium; Cleveland, OH, USA (24 May 1988).

Cryogenic turbomachinery of the type used to pump high-pressure liquid hydrogen at -423 F and liquid oxygen at -297 F to the main engines of the Space Shuttle are subjected to lateral rotor vibrations from unbalance forces and transient loads. Conventional dampers which utilize viscous fluids such as lubricating oil cannot be used in turbopumps because the bearing components are filled with either liquid hydrogen or liquid oxygen, which have viscosity comparable to air and, therefore, are not effective in viscous dampers. Electromagentic dampers are currently being explored as a means of providing damping in cryogenic turbopumps because their damping effectiveness increases as temperature decreases and because they are compatible with the liquid hydrogen or liquid oxygen in the turbopumps.

47150 **(ND-R—1485(D)) Decommissioning and demolition of four suites of high active chemical analysis cells at DNPDE.** Black, R.M.; Spence, B.W.; Stewart, C.W. (UKAEA Northern Research Labs., Risley). Nov 1987. 32p. NTIS (US Sales Only), PC A03/MF A01. Order Number DE88754292/JAW.

The decommissioning and demolition of four laboratory suites of high active cells at DNPDE is described. All four suites had suffered drain leaks of high active liquor into underfloor ducts; the options available at the time and current policy for dealing with the resultant activity deposits are given. The decommissioning procedures are detailed to provide information for future similar exercises. Features to ease demolition of such facilities and to eliminate the possibility of long term activity deposition from drain leaks are highlighted for incorporation in future designs. The waste arisings and radiation doses received during the work are tabulated.

47151 **(SAND—87-3011C) An approximate, maximum terminal velocity descent to a point.** Eisler, G.R.; Hull, D.G. (Sandia National Labs., Albuquerque, NM (USA)). 1987. Contract AC04-76DP00789. 15p. (CONF-880818—2). NTIS, PC A03/MF A01; 1; GPO Dep. Order Number DE88000349/JAW.

From Guidance, navigation and control conference; Minneapolis, MN, USA (15 Aug 1988).

No closed form control solution exists for maximizing the terminal velocity of a hypersonic glider at an arbitrary point. As an alternative, this study uses neighboring extremal theory to provide a sampled data feedback law to guide the vehicle to a constrained ground range and altitude. The guidance algorithm is divided into two parts: 1) computation of a nominal, approximate, maximum terminal velocity trajectory to a constrained final altitude and computation of the resulting unconstrained groundrange, and 2) computation of the neighboring extremal control perturbation at the sample value of flight path angle to compensate for changes in the approximate physical model and enable the vehicle to reach the on-board computed groundrange. The trajectories are characterized by glide and dive flight to the target to minimize the time spent in the denser parts of the atmosphere. The proposed on-line scheme successfully brings the final altitude and range constraints together, as well as compensates for differences in flight model, atmosphere, and aerodynamics at the expense of guidance update computation time. Comparison with an independent, parameter optimization solution for the terminal velocity is excellent. 6 refs., 3 figs.

47152 **National Bureau of Standards primary high-vacuum standard.** Tilford, C.R.; Dittmann, S.; McCulloh, K.E. (National Bureau of Standards, Center for Basic Standards, Gaithersburg, Maryland 20899). *Journal of Vacuum Science and Technology, A: Vacuum, Surfaces, and Films;* 6: No. 5, 2853-2859(Sep 1988).

The theory, design, operating procedures, and estimated errors are discussed for an orifice-flow-type pressure standard currently in use at the National Bureau of Standards. This standard is used to define pressures between 10^{-7} and 10^{-1} Pa. Including the uncertainty of the flowmeter, the estimated total uncertainty varies from 2.6% at the highest pressures, to 1.4% at midrange, and 8.2% at the lowest pressures. Representative calibration results are presented for four different types of hot-cathode ionization gauges.

4203 Lasers

REFER ALSO TO CITATION(S) 46498, 47225, 47495

47153 **(AD-A—192451/3/XAB) Regions of stability of FEL oscillators.** Levush, B.; Antonsen, T.M. (Maryland Univ., College Park (USA). Lab. for Plasma and Fusion Energy Studies). Oct 1987. 14p. (UMLPF—88-019). NTIS, PC A03/MF A01.

The stability of single-mode operation of FEL oscillators is investigated. Two models of an untapered FEL oscillator are considered. The first model is called the klystron model. In it the FEL interaction occurs at two points: a prebunching point and an energy-extraction point. In this model, the nonlinear electron dy-

namics are solvable exactly leading to a complex delay equation for the wave fields. The stability of single mode operation can then be determined easily as a function of single pass gain, energy mismatch-frequency, and the difference between the group velocity of the radiation and the beam velocity. The second, more-realistic model has a distributed interaction region of finite length. Stability of single-mode operation in this device must be determined numerically. The results of the models in low-gain regime will be compared and the parameter regimes where stable single-mode operation is possible will be determined.

47154 **(AD-A—192541/1/XAB) Efficiency optimization for FEL oscillators.** Serbeto, A.; Levush, B.; Antonsen, T.M. (Maryland Univ., College Park (USA). Lab. for Plasma and Fusion Energy Studies). Dec 1987. 24p. (UMLPF—88-031). NTIS, PC A03/MF A01.

Using a normalized set of nonlinear equations, which describe an free-electron-laser oscillator, the efficiency of energy extraction from the electron beam to the radiation can be optimized. The optimum values of this efficiency are presented for an (a) untapered and for a (b) tapered wiggler FEL oscillator.

47155 **(DOE/ER/30024—T3) Los Alamos XUV free electron laser proposal.** Fortson, N.; Hammer, D.; Rosenbluth, M. (Mitre Corp., McLean, VA (USA). Jason Program Office). Mar 1988. Contract AI01-82ER30024. 37p. (JSR—87-301). NTIS, PC A03/MF A01; 1; GPO Dep. Order Number DE88013485/JAW.

This report examines a proposed VUX/XUV free electron laser (FEL) facility. Issues examined include accelerator and mirror technology as well as FEL physics in general. As a result of this review specific recommendations are made. 4 refs, 8 figs.

47156 **(ENEA-RT-TIB—87-43) Contributions to the sixth symposium on atomic and surface physics.** Borsella, E. (ENEA, Rome (Italy)). Feb 1988. 20p. (CONF-880136—Exc.). NTIS (US Sales Only), PC A03/MF A01. Order Number DE88754235/JAW.

From 6. symposium on atomic and surface physics; La Plagne, France (17 Jan 1988).

The first contribution involves a discussion of experimental data obtained, by dye laser ionization time-of-flight (ToF) mass spectroscopy (allowing mass identification and wavelength scanning), on the fragmentation dynamics induced in dimethylzinc. The second contribution is a detailed study of the spectral and time dependance of fragment luminescence after dissociation of silane excited by pulsed carbon dioxide laser radiation. The experiment was performed to shed light on the mechanism of silane decomposition and reactions with additives. The final contribution examines the formation of ammonia clusters in a supersonic jet. Diode laser spectroscopy was employed in the investigation.

47157 **(ENEA-RT-TIB—87-48) Line tunable TEA carbon dioxide laser using SFUR configuration.** Barbini, S.; Ribezzo, S.; Ghigo, A.; Palucci, A. (ENEA, Rome (Italy)). Feb 1988. 12p. NTIS (US Sales Only), PC A03/MF A01. Order Number DE88754237/JAW.

We present the first TEA carbon dioxide line tunable laser to be obtained using the SFUR (Self Filtering Unstable Resonator) technique. Tunability (over 64 lines with high energy extraction efficiency E=3.8 J on the 10P20 line), single transverse and longitudinal mode operation and diffraction limited divergence are reported. The laser has been developed for the ENEA lidar facility at Frascati.

47158 **(INPE—4253-PRE/1126) Fabrication and characterization of semiconductor lasers of Pb(1-x)Sn(x)Te.** Abramof, E.; Olavoferreira, S.; Newtonbandeira, I. (Instituto de Pesquisas Espaciais, Sao Jose dos Campos (Brazil)). Jul 1987. 8p. NTIS, PC A02/MF A01.

The fabrication and characterization of PbTe homostructure diode lasers are described. The threshold current density is in the range between 2.5 and 10 KA/sq cm and the factors leading to device degradation are discussed.

47159 **(N—88-22133) Theoretical studies of Resonance Enhanced Stimulated Raman Scattering (RESRS) of frequency-doubled Alexandrite laser wavelength in cesium vapor. Progress report, January-June 1987.** Lawandy, N.M. (Brown Univ., Providence, RI (USA)). 1987. 56p. (NASA-CR—182870; NAS—1.26:182870). NTIS, PC A04/MF A01.

The solutions for the imaginary susceptibility of the Raman field transition with arbitrary relaxation rates and field strengths are examined for three different sets of relaxation rates. These rates correspond to: (1) Far Infrared (FIR) Raman lasers in the diabatic collision regime without consideration of coupled population decay in a closed system, (2) Raman FIR lasers in the diabatic collision regime with coupled population conserving decay, and (3) IR Raman gain in cesium vapor. The model is further expanded to include Doppler broadening and used to predict the peak gain as a function of detuning for a frequency doubled Alexandrite laser-pumped cesium vapor gain cell.

47160 **(PB—88-205604/XAB) Laser a electrons libres a fort gain (High-gain free-electron laser). Final report.** Buzzi, J.M. (Ecole Polytechnique, 91 - Palaiseau (France). Lab. de Physique des Milieux Ionises). Nov 1987. 10p. (PMI—1943). NTIS, PC E03/MF E03.

Text in French. See also PB—86-130929.

The authors were generally successful in achieving their research goals, which were: to build submillimeter, strong electromagnetic radiation sources, using the Cherenkov maser principle; to study the quality problems of strong beams usable in high-powered Raman millimeter free-electron lasers. The authors ran into a few problems in setting up the Thomson diffusion diagnostic, but feel they will resolve these shortly. They have begun collaboration with Thomson-CSF to design a free-electron gun using current technology, and to conduct experiments anticipating problems in the manufacture of industrial Raman free-electron lasers.

47161 **(SAND—88-1801C) Wavelength-resonant enhanced gain/absorption structure for standing-wave optoelectronic devices and its application to surface-emitting semiconductor lasers.** Raja, M.Y.A.; Brueck, S.R.J.; Osinski, M.; Schaus, C.F.; McInerney, J.G.; Brennan, T.M.; Hammons, B.E. (New Mexico Univ., Albuquerque (USA). Center for High Technology Materials; Sandia National Labs., Albuquerque, NM (USA)). 1988. Contract AC04-76DP00789. 10p. (CONF-880706—3). NTIS, PC A02/MF A01; 1; GPO Dep. Order Number DE88012858/JAW.

From International quantum electronics conference; Tokyo, Japan (18 Jul 1988).

A novel design for optoelectronic devices which utilize interaction between electromagnetic standing wave and carrier population is described. The structure consists of quantum well layers spaced at one half the wavelength of a particular optical transition in quantum wells. In such periodic medium, the gain (or absorption) for a selected wavelength determined by the periodicity is enhanced by a factor of two compared to uniform medium. The design has been implemented experimentally by growing a surface-emitting semiconductor laser structure in GaAs/AlGaAs system and have demonstrated lasing with the shortest gain medium length (320 nm) ever reported for a semiconductor laser. 7 refs., 4 figs.

47162 **(UCID—21452) Finesse degradation in Fabry-Perot fringes in the static mode.** McMillan, C. (Lawrence Livermore National Lab., CA (USA)). 5 Jul 1988. Contract W-7405-ENG-48. 6p. NTIS, PC A02/MF A01; 1; GPO Dep. Order Number DE88014188/JAW.

In experiments where we have measured the width of Fabry-Perot rings for different orders in a static ring pattern to determine the finesse, the finesse has been observed to decrease for the outer rings. This decrease in finesse appears to be caused by slight errors in focusing the lens used to produce the ring pattern. Computer simulations show that focusing errors as small as 0.2% of the focal length of the lens produce substantial decreases in the finesse for the outer rings in the pattern. 2 refs., 4 figs.

47163 **(UCRL—99179) PALADIN: A 10.6-μm free-electron laser amplifier.** Orzechowski, T.J. (Lawrence Livermore National Lab., CA (USA)). 15 Jul 1988. Contract W-7405-ENG-48. 20p. (CONF-880888—6). NTIS, PC A03/MF A01; 1; GPO Dep. Order Number DE88014164/JAW.

From Free electron laser seminar; Beijing, China (11 Aug 1988).

PALADIN is a 10.6-μm free-electron laser amplifier which uses a 45-MeV electron beam produced by a linear induction accelerator. We have measured single pass gain in excess of 25 dB through a 15-m wiggler and have demonstrated gain guiding. 4 refs., 13 figs.

47164 **(UCRL—99181) An introduction to the physics of high gain free electron lasers.** Orzechowski, T.J.; Prosnitz, D.; Scharlemann, E.T. (Lawrence Livermore National Lab., CA (USA)). 15 Jul 1988. Contract W-7405-ENG-48. 13p. (CONF-880888—5). NTIS, PC A03/MF A01; 1; GPO Dep. Order Number DE88014163/JAW.

From Free electron laser seminar; Beijing, China (11 Aug 1988).

Single pass Free Electron Laser Amplifiers using the electron beam generated by Linear Induction Accelerators are being developed at the Lawrence Livermore National Laboratory. The Free Electron Laser models used to describe these systems must account for finite transverse effects such as emittance. The basic equations as well as two-dimensional models are discussed here. 9 ref., 1 fig.

47165 **(UCRL—99183) Other properties of free electron lasers: Harmonics and optical guiding.** Orzechowski, T.J.; Scharlemann, E.T. (Lawrence Livermore National Lab., CA (USA)). 15 Jul 1988. Contract W-7405-ENG-48. 10p. (CONF-880888—3). NTIS, PC A02/MF A01; 1; GPO Dep. Order Number DE88014161/JAW.

From Free electron laser seminar; Beijing, China (11 Aug 1988).

Free electron lasers exhibit many interesting phenomena. During the gain process, electrons bunch, and these bunches radiate coherently at harmonics of the fundamental. These bunches can also be responsible for helping to guide the optical signal. We will discuss these topics in this lecture. 7 refs., 1 fig.

47166 **(UCRL—99184) Aspects of linear induction accelerator technology.** Orzechowski, T.J. (Lawrence Livermore National Lab., CA (USA)). 15 Jul 1988. Contract W-7405-ENG-48. 15p. (CONF-880888—4). NTIS, PC A03. Order Number DE88014162/JAW.

From Free electron laser seminar; Beijing, China (11 Aug 1988).

We discuss here some of the aspects associated with linear induction accelerators as they apply to free electron lasers. In particular, we address the formation of high brightness beams and of the pulsed power, which drives the accelerator. 8 refs., 7 figs., 1 tab.

47167 **(UCRL—99185) The Electron Laser Facility: Measurement of modes, harmonics, parametric dependence, and phase shift.** Orzechowski, T.J. (Lawrence Livermore National Lab., CA (USA)). 15 Jul 1988. Contract W-7405-ENG-48. 21p. (CONF-880888—1). NTIS, PC A03/MF A01; 1; GPO Dep. Order Number DE88014165/JAW.

From Free electron laser seminar; Beijing, China (11 Aug 1988).

The Electron Laser Facility has been used to investigate other phenomena associated with free electron lasers. In particular, we studied the gain in modes other than the fundamental design mode, harmonic generation, paramatic studies (FEL performance versus input power and electron beam current) and phase shift. 4 refs., 14 figs., 2 tabs.

47168 **(UCRL—99186) Overview of FEL [free-electron laser] development with induction linacs at LLNL.** Briggs, R.J. (Lawrence Livermore National Lab., CA (USA)). 15 Jul 1988. Contract W-7405-ENG-48. 18p. (CONF-880888—8). NTIS, PC A03/MF A01; 1; GPO Dep. Order Number DE88014179/JAW.

From Free electron laser seminar; Beijing, China (11 Aug 1988).

The multikiloampere peak currents available from linear induction accelerators make high-gain, free-electron laser amplifier configurations feasible. High extraction efficiencies in a single pass of the electron beam are possible if the wiggler parameters are appropriately "tapered," as recently demonstrated at millimeter wavelengths on the 4-MeV ELF facility. Magnetic pulse power systems enable high-repetition-rate operation of the accelerator for high-average-power applications. Key issues involved in extending the technology to shorter wavelengths and higher average powers are described. 3 refs., 8 figs.

47169 **Enhancements in the output energy of a KrF oscillator.** McCown, A.W.; Godard, J.A.B. (Laser Physics and Applications Group, Los Alamos National Laboratory, Los Alamos, New Mexico 87545). *Journal of Applied Physics;* **64**: No. 6, 2879-2884(15 Sep 1988).

Enhancements of up to 45% in the output energy of a KrF excimer laser have been observed following optical pumping of the resonator with as little as 1 mJ of 248-nm radiation from an external source. Polarization of the input beam leads to enhancement and partial polarization of the output pulse for time delays between the 2 pulses of up to 100 ns. Enhancement is not seen in seeding experiments performed on a KrF amplifier, indicating that the oscillator energy enhancement is due to optical seeding of the resonator cavity, resulting in a shorter amount of time required for the laser to reach threshold.

47170 **Absorption spectrum of $Kr_2F(4\ ^2\Gamma)$ in the near ultraviolet and visible (335≦λ≦600 nm): Comparison with Kr^+_2(1(1/2)/sub u/) measurements.** Geohegan, D.B.; Eden, J.G. (University of Illinois, Urbana, Illinois 61801). *Journal of Chemical Physics;* **89**: No. 6, 3410-3427(15 Sep 1988).

Absolute photoabsorption cross sections for the lowest excited state ($4\ ^2\Gamma$) of Kr_2F and the ground state (1(1/2)/sub u/) of Kr^+_2 have been measured in the visible and ultraviolet (Kr_2F: 248, 308, 335—600 nm; Kr^+_2 : 360—500 nm). As predicted by theory, the Kr_2F spectrum is dominated by the $9\ ^2\Gamma$left-arrow$4\ ^2\Gamma$ band which peaks below 340 nm and correlates with the Kr^+_2 2(1/2)/sub g/ left-arrow1(1/2)/sub u/ transition. However, $Kr_2F(4\ ^2\Gamma)$ and Kr^+_2 (1(1/2)/sub u/) both absorb more strongly for wavelengths beyond ~450 nm than expected, apparently owing to a nonthermalized Kr^+_2 vibrational distribution. Despite interference from Kr_2F stimulated emission between ~350 and 460 nm, the experimental results show the $Kr_2F(4\ ^2\Gamma)$ and Kr^+_2 absorption profiles to be similar for λ≧460 nm but diverging rapidly as λ increases from 335 to 360 nm. At 360 nm, the absorption cross sections differ by a factor of 3. Contrary to theoretical expectations, the Kr_2F absolute absorption cross section is consistently smaller (typically <40%) than that for Kr^+_2 which suggests that the impact of F^- on the Kr^+_2 oscillator strengths is significant.

47171 **High-irradiance 248-nm laser system.** Roberts, J.P.; Taylor, A.J.; Lee, P.H.Y.; Gibson, R. (Los Alamos National Laboratory, Los Alamos, New Mexico 87545). *Optics Letters;* **13**: No. 9, 734-736(Sep 1988).

A laser system that routinely generates irradiances of 8 x 10/sup 17/ W cm/sup -2/ is described. Pulses from a mode-locked visible dye laser are heterodyned to 248 nm and amplified in two KrF amplifiers. Output is 25—30 mJ in a 700-fsec pulse that can be focused to 5 μm².

47172 **Gain predictions for nickel-like gadolinium from a 181-level multiconfigurational distorted-wave collisional-radiative model.** Goldstein, W.H.; Oreg, J.; Zigler, A.; Bar-Shalom, A.; Klapisch, M. (High Temperature Physics Division, Lawrence Livermore National Laboratory, Livermore, California 94550). *Physical Review* [*Section*] *A: General Physics;* **38**: No. 4, 1797-1804(15 Aug 1988).

We present small-signal gain coefficients for soft x-ray transitions in nickel-like gadolinium. The gains are predicted by a steady-state collisional-radiative model containing 181 detailed levels, including $n = 5$ states. All possible electron collisional transitions among these levels are calculated in the distorted-wave approxima-

tion. Our calculations display features that may help to explain discrepancies between design predictions and the gains recently observed in a europium plasma. Also, we identify for the first time n = 3 to n = 3 inversions in the nickel-like ion that suggest that the "water window" at 43.7 A might be reached using such relatively low-Z elements as gadolinium.

47173 **Strong-field dynamics of a multimode, standing-wave dye laser.** Raymer, M.G.; Deng, Z.; Beck, M. (The Institute of Optics, University of Rochester, Rochester, New York 14627). *Journal of the Optical Society of America B: Optical Physics;* 5: No. 8, 1588-1595(Aug 1988).

A set of strong-field Maxwell—Bloch equations is derived for a multimode, standing-wave, homogeneously broadened laser such as a dye laser, which obeys the atomic rate-equation limit. Numerical solutions show that the energy in the cavity oscillates between the field and the gain medium at multiples of the cavity mode spacing. By using these Maxwell—Bloch equations, intensity autocorrelation functions of a dye-laser system under varying conditions are calculated. We find that the numerical results qualitatively agree with recent experimental data.

47174 **Gain enhancement in a XeCl-pumped Raman amplifier.** Rifkin, J.; Bernt, M.L.; MacPherson, D.C.; Carlsten, J.L. (Department of Physics, Montana State University, Bozeman, Montana 59717). *Journal of the Optical Society of America B: Optical Physics;* 5: No. 8, 1607-1612(Aug 1988).

A comparison of the theoretical predictions of a multimode broadband model with the experimentally measured gain enhancement in a Raman amplifier is presented. The results show that the multimode theory with fixed and totally random phases is in agreement with the data obtained from an excimer-laser-pumped Raman amplifier. Additionally, this theory indicates that the correlated gain can be larger than the gain for a monochromatic laser, as might be expected for a model with amplitude modulation.

47175 **High-power pseudospark and BLT switches.** Frank, K.; Boggasch, E.; Christiansen, J.; Goertler, A.; Hartmann, W.; Kozlik, C.; Kirkman, G.; Braun, C.; Dominic, V.; Gundersen, M.A. (Physikalisches Institut, Univ. of Erlangen-Nurnberg, D-8520 Erlangen (DE)). *IEEE (Institute of Electrical and Electronics Engineers) Transactions on Plasma Science;* 16: No. 2, 317-323(Apr 1988).

A review of recent developments in a new group of high-power hollow-electrode switches, including the pseudospark and the backlighted thyratron (BLT), is presented. Experiments demonstrate that for several key high-power switching performance factors, the pseudospark and BKT switches are superior to either high-pressure spark gap switches or thyratrons or, in some cases, both. High performance has been demonstrated in peak current (>100 kA), current rate of rise (>10/sup 12/ A/s), switching precision, trigger efficiency, current reversal (100 percent), and recovery time. Several electrical and optical trigger methods have been demonstrated and are described. Pseudosparks and BLT's have also been tested as switches for different types of gas lasers, including copper vapor, N/sub 2/, and excimer lasers.

47176 **(ESA-TT—1068) Optimization of metal-dielectric laser mirrors of TiO_2/SiO_2 and silver.** Schmitt, D.R.; Rosteck, H. (European Space Agency, 75 - Paris (France)). Dec 1987. Translation of Optimierung von Metallisch-Dielektrischen Laserspiegeln aue der Basis von TiO_2/SiO_2 und Silber (Brunswick, Fed. Republic of Germany, DFVLR), 61 (Sep 1986). (DFVLR-FB—86-57; ETN—88-91975). 62p. NTIS, PC A04/MF A01; original German version available from DFVLR, VB-PL-DO, 90 60 58, 5000 Cologne, Fed. Republic of Germany 22.50 DM.

Laser mirrors for laser gyroscope applications were developed. The interference coatings were a combination of TiO_2 and SiO_2 with Ag coatings. An improvement of the cleaning process considerably improves the quality of the mirrors. A maximum value of 0.9996 for the reflectivity (R), and a minimum value of 0.00014 for the backscattering (S) are achieved. The maximum achievable R is mainly determined by the backscattering properties of the coatings. Mirrors without Ag coating have a worse S. The constancy of the coating thickness has to be improved.

4204 Heat Transfer And Fluid Flow

REFER ALSO TO CITATION(S) 46271, 46316, 46469, 46470, 46471, 46490, 46716, 47139, 47209

47177 **(AGARD-CP—413) Aerodynamic and related hydrodynamic studies using water facilities.** (Advisory Group for Aerospace Research and Development, 92 - Neuilly-sur-Seine (France)). Jun 1987. 462p. (In several languages). (CONF-8610430—). NTIS, PC A20/MF A01.

From Aerodynamic and related hydrodynamic studies using water facilities; Monterey, CA, USA (20 Oct 1986).

Original contains color illustrations.

Related problems, experiences and advancements in aeronautical and maritime fluid dynamics through the use of water facilities are reviewed. In recent years there has been an increasing use of water facilities for aerodynamic investigations. These include water tunnels, towing channels, and stationary tanks. Examples include basic research problems as well as flow fields around fighter aircraft, inlet flows, recirculation flow patterns associated with VTOL, ramjet simulation, etc., and, in general, 3-D flows with vortices or separated regimes as prominent features. The Symposium was organized to provide an appropriate forum for the exchange of information within the aeronautical and maritime fluid dynamics community.

47178 **(DOE/MC/21353—2584) On the constitutive relation for frictional flow of granular materials: Topical report.** Gray, D.D.; Stiles, J.M. (West Virginia Univ., Morgantown (USA). Dept. of Civil Engineering; EG and G Washington Analytical Services Center, Inc., Morgantown, WV (USA)). Mar 1988. Contract AC21-85MC21353. 28p. NTIS, PC A03. Order Number DE88001089/JAW.

The flow of granular materials is an economically important phenomenon which is poorly understood. Granular materials may flow in several regimes: gas-solid two phase flow, rapid flow, or frictional flow. The purpose of this report is to develop a constitutive relation for the frictional flow regime in which the grains slide or roll over one another. Ultimately this relation will be incorporated into a large computer code which will be able to simulate all aspects of the motion of bed material in fluidized bed combustors. 13 refs., 6 figs., 2 tabs.

47179 **(DOE/PC/90960—8) Rheology of high concentration polymodal multiphase flow: Quarterly report.** Probstein, R.F. (Massachusetts Inst. of Tech., Cambridge (USA)). Jul 1988. Contract FG22-86PC90960. 5p. NTIS, PC A02/MF A01; 1; GPO Dep. Order Number DE88014541/JAW.

Based on the MIT bimodal concept, it has been shown that the shear-dependent viscosity of coal-water mixtures is soley influenced by the presence of micron size colloidal particles and that the effect of the coarse particles which behave independently of the applied shear rates, is to increase the shear rate on the colloidal fraction to a higher effective value. In the last quarterly report, an expression was obtained that relates the effectively shear rate to the coarse particle volume fraction, {phi}/sub c/. The expression was based on the hydrodynamic concepts, because of the non-colloidal behavior of the coarse particles, and it employed two empirical parameters: a matching constant of order unity and the maximum volume fraction at which the suspension can be sheared, {phi}/sub m/. During this last quarterly period, this expression has been applied to the viscosity experiments runs at MIT on bimodal coal slurries. The shear-independent contribution, {eta}/sub cr/, of the coarse particles to the net relative viscosity is thus calculated for different coarse volume fractions, {phi}/sub c/, and the results are shown in Fig. 1. As a cross-check on the procedure, we plot in the same figure the previously obtained relative viscosity results of suspensions of coarse particles in glycerin at different loadings. The agreement between the results of the two independent experiments, we believe, strongly supports the ideas behind the MIT bimodal theory. An expression was next obtained on theoretical grounds to relate the shear-independent coarse relative viscosity, {eta}/sub c/, to {phi}/sub c/, and its derivation is summarized. 3 refs., 1 fig.

47180 **(DOE/PC/90962—T7) Experiments on densely-loaded non-Newtonian slurries in laminar and turbulent pipe flows: Quarterly technical progress report No. 7.** Park, J.T.; Mannheimer, R.J.; Grimley, T.A.; Morrow, T.B. (Southwest Research Inst., San Antonio, TX (USA)). 28 Jul 1988. Contract FG22-86PC90962. 4p. (SWRI—06-1364). NTIS, PC A02/MF A01; 1; GPO Dep. Order Number DE88014098/JAW.

An experimental description of the flow structure of non-Newtonian slurries in the laminar, transitional, and full turbulent pipe flow regimes is the primary objective of this research. Measurements include rheological characterization of the fluid and local fluid velocity measurements with a laser Doppler velocimeter (LDV). Optical access to the flow is gained through a test section and model slurry which are both transparent. The model slurry is formulated from silica gel particles and hydrocarbon liquid mixture whose indices of refraction are matched so that light is not scattered from the particles. Experiments were conducted in a large-scale pipe slurry flow facility with an inside pipe diameter of 51 mm (2 inches). Detailed flow measurements including turbulence quantities such as Reynolds stress components were measured with a two-component two-color LDV. Results are discussed. 4 refs., 4 figs., 1 tab.

47181 (N—88-22408, pp vp) **Research sensors.** Englund, D.R. May 1988. NTIS, PC A16/MF A01. (NASA-CP—3003-VOL-3; E—3970-VOL-3; NAS—1.55:3003-VOL-3; CONF-8805178—).

From Lewis structures technology symposium; Cleveland, OH, USA (24 May 1988).

The work described is part of a program (Englund and Seasholtz, 1988) to develop sensors and sensing techniques for research applications on aircraft turbine engines. In general, the sensors are used to measure the environment at a given location within a turbine engine or to measure the response of an engine component to the imposed environment. Locations of concern are generally in the gas path and, for the most part, are within the hot section. Specific parameters of concern are dynamic gas temperature, heat flux, airfoil surface temperature, and strain on airfoils and combustor liners. To minimize the intrusiveness of surface-mounted sensors, a considerable effort was expended to develop thin-film sensors for surface temperature, strain, and heat flux measurements. In addition, an optical system for viewing the interior of an operating combustor was developed. Most of the work described is sufficiently advanced that the sensors were used and useful data were obtained. The notable exception is the work to develop a high-temperature static strain measuring capability; the work is still in progress.

47182 **(N—88-23086) Studying turbulence using numerical simulation databases. Proceedings of the 1987 Summer program.** Moin, P.; Reynolds, W.C.; Kim, J. (Stanford Univ., CA (USA)). Dec 1987. 322p. (NASA-CR—182692; NAS—1.26:182692; SU—CTR-S87; CONF-8707190—). NTIS, PC A14/MF A01.

From Summer program on studying turbulence using numerical simulation databases; Stanford, CA, USA (13 Jul 1987).

The focus was on the use of databases obtained from direct numerical simulations of turbulent flows, for study of turbulence physics and modeling. Topics addressed included: stochastic decomposition/chaos/bifurcation; two-point closure (or k-space) modeling; scalar transport/reacting flows; Reynolds stress modeling; and structure of turbulent boundary layers.

47183 **(N—88-23171) Experimental studies of vortex flows. Final report, March 1984-May 1988.** Roberts, L.; Mehta, R. (Stanford Univ., CA (USA)). Jun 1988. 8p. (NASA-CR—182874; NAS—1.26:182874). NTIS, PC A02/MF A01.

This final report describes research work on vortex flows done during a four-year period beginning in March 1984 and funded by NASA Grant NCC2-294 from the Fluid Dynamics Research Branch of NASA Ames Research Center. After a brief introduction of the main topics addressed by the completed research, the accomplishments are summarized in chronological order.

47184 **(N—88-23185) Two-equation low-Reynolds-number turbulence modeling of transitional boundary layer flows characteristic of gas turbine blades. Ph.D. Thesis. Final Contractor Report.** Schmidt, R.C.; Patankar, S.V. (Minnesota Univ., Minneapolis (USA)). May 1988. 273p. (NASA-CR—4145; E—3960; NAS—1.26:4145). NTIS, PC A12/MF A01.

The use of low Reynolds number (LRN) forms of the k-epsilon turbulence model in predicting transitional boundary layer flow characteristic of gas turbine blades is developed. The research presented consists of: (1) an evaluation of two existing models; (2) the development of a modification to current LRN models; and (3) the extensive testing of the proposed model against experimental data. The prediction characteristics and capabilities of the Jones-Launder (1972) and Lam-Bremhorst (1981) LRN k-epsilon models are evaluated with respect to the prediction of transition on flat plates. Next, the mechanism by which the models simulate transition is considered and the need for additional constraints is discussed. Finally, the transition predictions of a new model are compared with a wide range of different experiments, including transitional flows with free-stream turbulence under conditions of flat plate constant velocity, flat plate constant acceleration, flat plate but strongly variable acceleration, and flow around turbine blade test cascades. In general, calculational procedure yields good agreement with most of the experiments.

47185 **(N—88-23187) Laser Doppler anemometry.** Johnson, D.A. (National Aeronautics and Space Administration, Moffett Field, CA (USA). Ames Research Center). Jun 1988. 13p. (NASA-TM—100072; A—88101; NAS—1.15:100072). NTIS, PC A03/MF A01.

The material in this NASA TM is to appear as a chapter on Laser Doppler Anemometry (LDA) in the AGARDograph entitled, A Survey of Measurements and Measuring Techniques in Rapidly Distorted Compressible Turbulent Boundary Layers. The application of LDA (specifically, the dual-beam, burst-counter approach) to compressible flows is discussed. Subjects treated include signal processing, particle light scattering and tracking, data reduction and sampling bias, and three-dimensional measurements.

47186 **(N—88-23194) Effect of mass-velocity on liquid jet atomization in Mach 1 gasflow.** Ingebo, R.D. (National Aeronautics and Space Administration, Cleveland, OH (USA). Lewis Research Center). 1988. 8p. (NASA-TM—100813; E—3944-1; NAS—1.15:100813; CONF-880898—). NTIS, PC A02/MF A01.

From 4. international conference on liquid atomization and spray systems; Sendai, Japan (22 Aug 1988).

Interacting two-phase flow in four differently sized pneumatic two-fluid atomizers was investigated to determine the effect of gas mass-velocity on the Sauter mean diameter of sprays produced by small diameter liquid jets breaking up in high velocity gas flow. Tests were conducted primarily in the acceleration-wave regime for liquid jet atomization, where it was found that the loss of droplets due to vaporization had a marked effect on drop size measurements. A scattered-light scanner, developed at NASA Lewis Research Center, was used to measure the Sauter mean diameter, D sub 32, which was correlated with nitrogen gas mass-velocity to give the following expression: D (sup -1)(sub 32) = 11.7(rho (sub n) V (sub n)) (sup 1.33). The exponent 1.33 for the gas mass-velocity is identical to that predicted by atomization theory for liquid jet breakup in the acceleration-wave regime.

47187 **(UCRL—97361) On the use of particle tracking methods for solute transport in porous media.** Tompson, A.F.B.; Dougherty, D.E. (Lawrence Livermore National Lab., CA (USA); California Univ., Irvine (USA). Dept. of Civil Engineering). Jan 1988. Contract W-7405-ENG-48. 7p. (CONF-880672—3). NTIS, PC A02/MF A01; 1; GPO Dep. Order Number DE88008913/JAW.

From 7. international conference on computation methods in water resources; Cambridge, MA, USA (13 Jun 1988).

The numerical solution of the advection-diffusion (-reaction) equation in any of its forms remains the object of much research after decades of work. In this paper we review briefly the applicaiton of particle methods for the solution. We point out many of the

advantages, disadvantages, difficulties, and pleasures of using the technique. Particle tracking methods have been used to solve partial differential equations in a variety of application areas. They are based on representing the distribution of an extensive quantity, such as the mass of a particular solute species, as a large colleciton of particles. At every point in time, a particle is associated with a position in the flow domain, and perhpas other attributes such as mass, charge, or species type. In addition, each particle may be associated with a velocity, certain diffusion characteristics, or other type of forcing vector,each of which may be space dependent. Individual particles are displaced in space over discrete increments of time by these forces. In many cases, a particle distribution at an advanced time level may serve to modify or update the displacement forces. In general, a particle technique is a numerical method for the solution of a time-dependent problem on a region Ω in which the unknown function is approximated at each time t by a linear combination of a finite set of Dirac measures in space. 24 refs.

47188 **Turbulence structure in free-surface channel flows.** Rashidi, M.; Banerjee, S. (Department of Chemical and Nuclear Engineering, University of California, Santa Barbara, California 93106). *Physics of Fluids;* 31: No. 9, 2491-2503(Sép 1988).

A turbulence structure in horizontal liquid streams bounded by a free surface and a wall has been investigated using 10—25 μm oxygen bubbles as tracers. High speed video movies indicate that the dominant flow structure is caused by the periodic ejection of intensely turbulent fluid with low streamwise momentum from the wall region into the relatively quiescent bulk fluid which it displaces and mixes with slowly. The motion of these bursts is constrained by the free interface. Between bursts and the interface a high speed region with a steep velocity gradient develops as a consequence. This in turn causes progress of the burst fluid toward the interface to slow down and eventually to turn back toward the wall, giving rise to characteristic rolling structures, which rotate clockwise if the flow is viewed as going from left to right. To complement the video studies, quantitative data were obtained by analyzing bubble streak lines generated by photography of optically chopped flashes. These data show that in the vicinity of the interface the velocity fluctuations normal to it are damped whereas those parallel to it are enhanced. Analysis of conditional samples of the data indicate that fluid with relatively low streamwise momentum tends to move toward the interface while fluid with high momentum moves away giving rise to rotating structures that roll along with the flow in agreement with the video studies. A high degree of correlation between ejection events near the wall and the fluid motion near the interface also confirm that the bursts extend across the flow stream. This has important implications for surface renewal theories of turbulent transport at fluid—fluid interfaces.

47189 **Dynamics of explosive boiling of a droplet.** Frost, D.L. (Graduate Aeronautical Laboratories, California Institute of Technology, Pasadena, California 91125). *Physics of Fluids;* 31: No. 9, 2554-2561(Sep 1988).

The dynamical behavior of the unstable explosive boiling of single droplets (1—2 mm diam) of diethyl ether, pentane, and isopentane at the superheat limit has been exhibited in detail. At high ambient pressures, boiling consists of normal stable growth of a smooth bubble. At intermediate pressures a transitional regime of stability occurs in which a drop initially vaporizes stably for several milliseconds while incipient instability waves develop on the evaporating interface, then increased heat flux from the host liquid initiates violent boiling near the edge of the remnant volatile liquid. Direct evidence has been obtained that during violently unstable boiling, fine liquid particles are torn from the liquid—vapor interface, generating a mass flux orders of magnitude greater than that characteristic of ordinary boiling. In this regime of transitional stability, one of a number of different possible kinds of disturbances could externally trigger a breakdown to violent instability. After the evaporative instability becomes nonlinear and saturates, the boiling appears quasisteady, with the evaporative front moving into the volatile liquid at a roughly constant velocity. Results obtained by modeling the evaporation wave as a Chapman—Jouguet deflagration show that the temperature at the unstably boiling interface is substantially above the saturated value.

47190 **(ESA-TT—1076) Comparison of different kinds of compact crossflow heat exchangers.** Siemens, W. (European Space Agency, 75 - Paris (France)). Mar 1988. Translated of Vergleichende Rechnungen an Kompakten Platten- und Profil-Waermetauschern (Cologne, Fed. REpublic of Germany, DFVLR), 82 (Sep 1986). (DFVLR-FB—86-63; ETN—88-92558). 80p. NTIS, PC A05/MF A01; original German version available from DFVLR, VB-PL-DO, 90 60 58, 5000 Cologne, Fed. Republic of Germany 29.50 DM.

A computer program for the calculation of compact heat exchangers for gas turbines was developed. The most important coefficients, pressure drops, and effectiveness of different kinds of exchangers were calculated as a function of Mach number, the dimensions of the exchanger, and the compactness. From the aerothermodynamic point of view, the plate exchanger is best, closely followed by the lancet heat exchanger. The ribs of the plate version have no significant effect on the characteristics, but are required for stiffness and uniform channel height. The tube heat exchanger can only compete as far as the transferable heat is concerned.

47191 **Vectorization of a thermal-hydraulics code on the CRAY X-MP.** Sills, E.D.; Doster, J.M. *Transactions of the American Nuclear Society;* 55: 329-330(1987). (CONF-8711195—).

From American Nuclear Society winter meeting; Los Angeles, CA, USA (15 Nov 1987).

A thermal-hydraulics code named FLOC, developed specifically to investigate parallel numerical algorithms for solution of the area-averaged Navier-Stokes equations, was originally written to run on a VAX minicomputer and later implemented on a CRAY X-MP. The FLOC code utilizes a semiimplicit formulation to produce a linear system in the spatial pressure distribution at each time step. As transported, the code ran at just over 4 MFLOPs and required 25 CPUs to complete a 10-s pump startup transient for a 72-volume/84-junction two-loop representation of a pressurized water reactor. After restructuring to enhance vectorization by the CRAY vectorizing compiler (version 1.15), the same transient ran at > 23 MFLOPs in < 4 CPUs using fixed time steps. The same simulation allowing variable time steps ran in 0.7 s, more than 10 times faster than real time. The FLOC code consists of eight subroutines, which are called at each time step, and several additional subroutines, which perform initialization and input/output operations. The code allows several choices of direct and iterative algorithms for the matrix solution. The authors have previously reported the preference for direct solution techniques, and the results reported here use the TR algorithm for matrix solutions.

47192 **Application of an electrodynamic balance to study mass transfer from a single particle.** Kale, S.R.; Webster, W.P.; Anderson, R.J. (Dept. of Mechanical and Aerospace Engineering, West Virginia Univ., Morgantown, WVA (US)). pp 83-90 of Developments in experimental techniques in heat transfer and combustion. Warrington, R.O. Jr.; Chen, M.M.; Felske, J.D.; Grosshandler, W.L. New York, NY; American Society of Mechanical Engineers (1987). (CONF-870816—).

From 24. national heat transfer conference and exhibition; Pittsburgh, PA, USA (9 Aug 1987).

Mass transfer from subliming naphthalene particles was studied in an electrodynamic balance. DC and AC potentials were applied to a pair of end electrodes and a central (ring) electrode, respectively, and charged naphthalene particles, irregular in shape, were suspended in the resulting electric field. An air jet entered the balance through a hole in the bottom electrode and exited through a hole in the top electrode. LDA measurements of this jet indicated a uniform flow field for 10 diameters around a particle, 200 μm in diameter. Mass change was interpreted from the DC potential, and size changes from the video image. The results indicate that for forced convection, with or without particle rotation, the Sherwood number is strongly dependent on Reynolds number, and is almost constant at 3.1 for natural convection. The mass transfer rates varied widely for a given velocity due to arbitrary variations in particle shape and size. These experiments indicate that the electrodynamic balance is a powerful device for studying mass transfer from a single particle or a liquid drop.

4205 Materials Testing

REFER ALSO TO CITATION(S) 46914, 46930, 46931, 47491

47103 **(ANL—88-6) Advanced thermoplastic materials for district heating piping systems.** Raske, D.T.; Karvelas, D.E. (Argonne National Lab., IL (USA)). Apr 1988. Contract W-31109-ENG-38. 22p. NTIS, PC A03/MF A01; 1; GPO Dep. Order Number DE88012714/JAW.

The work described in this report represents research conducted in the first year of a three-year program to assess, characterize, and design thermoplastic piping for use in elevated-temperature district heating (DH) systems. The present report describes the results of a program to assess the potential usefulness of advanced thermoplastics as piping materials for use in DH systems. This includes the review of design rules for thermoplastic materials used as pipes, a survey of candidate materials and available mechanical properties data, and mechanical properties testing to obtain baseline data on a candidate thermoplastic material extruded as pipe. The candidate material studied in this phase of the research was a polyetherimide resin, Ultem 1000, which has a UL continuous service temperature rating of 338{degree}F (170{degree}C). The results of experiments to determine the mechanical properties between 68 and 350{degree}F (20 and 177{degree}C) were used to establish preliminary design values for this material. Because these prototypic pipes were extruded under less than optimal conditions, the mechanical properties obtained are inferior to those expected from typical production pipes. Nevertheless, the present material in the form of 2-in. SDR 11 pipe (2.375-in. O. D. by 0.216-in. wall) would have a saturated water design pressure rating of {approximately}34 psig at 280{degree}F. 16 refs., 6 figs., 8 tabs.

47104 **(FhG-IzfP—860130-TW) Investigations for developing an equipment component for the excitation of shear horizontal waves by segmented, electromagnetic ultrasonic transducers. Final report.** Kapitza, H.; Huebschen, G.; Replinger, W. (Fraunhofer-Gesellschaft zur Foerderung der Angewandten Forschung e.V., Saarbruecken (Germany, F.R.). Inst. fuer Zerstoerungsfreie Pruefverfahren). 31 Jul 1986. 70p. (In German). NTIS (US Sales Only), PC A04/MF A01. Order Number DE88754585/JAW.

For the transmitter of the EMUS device, a maximum pulse power of at least 3.0 kW per transmitter channel has been achieved by parallel connection of four transistor output stages, and thus the load limit of usual EMUS transducer coils is reached. Novel operational amplifiers can reduce the background noise of the preamplifiers for the EMUS device by 5 dB. Simultaneous reduction of power input and volume allow the pre-amplifiers to be integrated into the casing of the TR-EMUS scanning heads. By optimizing the magnetic field (segmentation also perpendicular to incoming wave plane) and the HF-coil (meander-type winding with edgewise wound return path), the amplifying reserve of a segmented SH-EMUS transducer has been increased by 15 dB to 34 dB (TR device, 3 segments, 3 elements).

47105 **(IYF-R—5,9-298) Technique for in-pile testing of fuel element cladding in complex stress state.** Ashrapov, T.B.; Kartsev, A.A.; Loshchilin, V.P.; Semenov, B.D.; Sulajmonov, M.G.; Khalilov, Kh.T. (AN Uzbekskoj SSR, Tashkent. Inst. Yadernoj Fiziki). 1987. 13p. (In Russian). NTIS (US Sales Only), PC A03/MF A01. Order Number DE88703638/JAW.

Technique, which is based on alternating-sign load of pipe samples in complex stressed state, and which allows to obtain complex of physical-mechanical features of the materials studied under reactor irradiation, is presented. Besides, <<BUKD-T>> developed experimental installation, which realizes the given technique, is described. 4 refs.; 4 figs.

47106 **(UCID—21411) Experiments in the application of ultrasound diffraction tomography for nondestructive testing.** Azevedo, S.G.; Fitch, J.P. (Lawrence Livermore National Lab., CA (USA)). Jul 1988. Contract W-7405-ENG-48. 15p. NTIS, PC A03/MF A01; 1; GPO Dep. Order Number DE88014694/JAW.

We have designed computer programs to simulate ultrasound projection scans and to reconstruct the tomographic planar image. We have also used the reconstruction algorithm on actual test data and have obtained a crude but promising image. 11 refs., 9 figs.

4208 Electronic Circuits And Devices

REFER ALSO TO CITATION(S) 46553, 46965, 46992, 47008, 47133, 47154, 47279

47107 **(LBL—24220) Quad time-to-amplitude converter (LBL No. 21X9191 P-1).** McDonald, R.J.; Landis, D.A.; Wozniak, G.J. (Lawrence Berkeley Lab., CA (USA)). Feb 1988. Contract AC03-76SF00098. 10p. NTIS, PC A03/MF A01; 1; GPO Dep. Order Number DE88014052/JAW.

Four Time-to-Amplitude Converters (TACs) have been designed and packaged in a single-width NIM module. These moderate-resolution units ({approximately}0.1{percent} full scale) are ideal for applications where large numbers of TACs are required because of the high packing density provided by the quad configuration. Full-scale ranges of 100 ns, 300 ns, 1 μs, and 3 μs are switch selectable. Read out of each unit may be either internally or externally controlled. All units may be read out at the same time via a common {open+-quotes}group readout{close+-quotes}. The readout time is adjustable between 2 and 20 μs. An LED indicates a valid event. 4 figs.

47108 **(SAND—88-1144) Rotor instrumentation circuits for the Sandia 34-meter vertical axis wind turbine.** Sutherland, H.J.; Stephenson, W.A. (Sandia National Labs., Albuquerque, NM (USA)). Jul 1988. Contract AC04-76DP00789. 76p. NTIS, PC A05/MF A01; 1; GPO Dep. Order Number DE88014704/JAW.

Sandia National Laboratories has erected a research oriented, 34-meter diameter, Darrieus vertical axis wind turbine near Bushland, Texas, which has been designated the Sandia 34-m VAWT Test Bed. To meet present and future research needs, the machine was equipped with a large array of sensors. This manuscript details the sensors initially placed on the rotor, their respective instrumentation circuits, and the provisions incorporated into the design of the rotor instrumentation circuits for future research. This manuscript was written as a reference manual for the rotor instrumentation of the Test Bed. 16 refs., 8 figs., 7 tabs.

47109 **Pressure dependence of Schottky barrier height at the Pt/GaAs interface.** Shan, W.; Li, M.F.; Yu, P.Y.; Hansen, W.L.; Walukiewicz, W. (Department of Physics, University of California, and Materials and Chemical Sciences Division, Lawrence Berkeley Laboratory, Berkeley, California 94720). *Applied Physics Letters;* 53: No. 11, 974-976(12 Sep 1988).

The Schottky barrier height at the Pt/GaAs interface has been measured as a function of pressure using a diamond anvil cell. The Schottky barrier height was found to shift to higher energy with a linear pressure coefficient of 11 meV/kbar, which is equal to the pressure coefficient of the fundamental gap of GaAs and with a nonlinear coefficient of -0.26 meV/kbar^2. These results are discussed in terms of defect models which have been proposed to explain the Fermi level pinning in Schottky barriers.

47200 **Effect of post-oxidation anneal temperature on radiation-induced charge trapping in metal-oxide-semiconductor devices.** Schwank, J.R.; Fleetwood, D.M. (Sandia National Laboratories, Albuquerque, New Mexico 87185). *Applied Physics Letters;* 53: No. 9, 770-772(29 Aug 1988).

Polycrystalline silicon-gate metal-oxide-semiconductor (MOS) capacitors have been fabricated with high-temperature anneals from 800 to 950 °C after gate oxidation and polycrystalline silicon deposition. Temperatures from 800 to 875 °C are found to have very little effect on the radiation response of these devices. However, a rapid increase in radiation-induced oxide-trapped charge, ΔV/sub ot/, is observed for anneal temperatures above 875 °C. This increase in ΔV/sub ot/ coincides with an experimentally observed change in the polycrystalline silicon grain structure. The

anneal temperature was found to have a much smaller effect on radiation-induced interface-trap charge. The correlation of these results to other properties, e.g., stress, is discussed.

47201 **Long-term radiation effects on gallium arsenide directional coupler optical waveguides.** McWright, G.; Lowry, M.; Roeske, F.; Takeuchi, E. (Lawrence Livermore National Lab., P.O. Box 808, Livermore, CA (US)). *IEEE (Institute of Electrical and Electronics Engineers) Transactions on Nuclear Science;* 35: No. 1, 951-953(Feb 1988).

The authors discuss the effect of 1.17 MeV and 1.33 MeV gamma rays on the propagation characteristics of gallium arsenide directional coupler optical waveguides. Radiation doses ranged from 4100-190000 rad (GaAs).

47202 **Oxygen-nitrogen interactions in ion-implanted silicon.** Stein, H.J. (Sandia National Labs., Albuquerque, NM (US)). pp 287-290 of Microscopic identification of electronic defects in semiconductors. Johnson, N.M.; Bishop, S.G.; Watkins, G.D. Pittsburgh, PA; Materials Research Society (1985). (CONF-850421—).

From 2. spring meeting of the Materials Research Society; San Francisco, CA, USA (15 Apr 1985).

Interaction of oxygen and nitrogen in ion-implanted crystalline silicon layers has been investigated by infrared absorption. Infrared absorption bands which are not produced by either /sup 14/N or /sup 16/O alone are observed after sequential implantation of /sup 14/N and /sup 16/O into overlapping profiles followed by annealing at 500°C. The new bands indicator oxygen - nitrogen interactions and are ascribed to Si-N vibrational modes with oxygen in nearby interstitial sites.

47203 **The effect of hydrostatic pressure on defect annealing in semiconductors.** Barnes, C.E.; Samara, G.A. (Sandia National Labs., Albuquerque, NM (US)). pp 471-476 of Microscopic identification of electronic defects in semiconductors. Johnson, N.M.; Bishop, S.G.; Watkins, G.D. Pittsburgh, PA; Materials Research Society (1985). (CONF-850421—).

From 2. spring meeting of the Materials Research Society; San Francisco, CA, USA (15 Apr 1985).

The authors report the first study of the effect of hydrostatic pressure on the annealing of defects in Si and GaAs. It is shown that the application of hydrostatic pressure enhances the annealing rate in these materials. Analysis of the data yields the lattice volume relaxation accompanying annealing.

47204 **Defect identification in high-purity semiconductors.** Haller, E.E. (Univ. of California and Lawrence Berkeley Lab., Berkeley, CA (US)). pp 495-506 of Microscopic identification of electronic defects in semiconductors. Johnson, N.M.; Bishop, S.G.; Watkins, G.D. Pittsburgh, PA; Materials Research Society (1985). (CONF-850421—).

From 2. spring meeting of the Materials Research Society; San Francisco, CA, USA (15 Apr 1985).

The elemental semiconductors silicon and germanium can be purified to electrically active impurity concentrations as low as — 10/sup 10/cm/sup -3/. Highly sensitive, energy dispersive analytical techniques have been developed to identify and measure the concentration of the residual elemental impurities. The application of these techniques to very pure materials has also resulted in the discovery of a large number of new levels which are due to impurity/defect complexes. Photothermal ionization spectroscopy using uniaxial stress or a magnetic field, electron paramagnetic resonance, and doping experiments using stable and radioactive elements have been used in combination to identify the composition and the structure of some of the new centers.

47205 **Structural and electrical characterization of polycrystalline semiconductor materials.** Matson, R.J.; Tsuo, Y.S. (Solar Energy Research Institute, Golden, CO (US)). pp 567-574 of Microscopic identification of electronic defects in semiconductors. Johnson, N.M.; Bishop, S.G.; Watkins, G.D. Pittsburgh, PA; Materials Research Society (1985). (CONF-850421—).

From 2. spring meeting of the Materials Research Society; San Francisco, CA, USA (15 Apr 1985).

Secondary electron imaging, electron channeling and electron-beam-induced current (EBIC) are used alternately in a scanning electron microscope to characterize and correlate the morphology, crystallographic orientation, and electronic quality (types and spatial distribution of defects) of individual grains in polycrystalline semiconductor samples. The technique is discussed in some detail, and a number of applications and results in the study of edge-supported-pulling (ESP) silicon sheet and low-angle silicon sheet (LASS) materials are reported.

47206 **A study of Co and Mn in ZnO varistors.** Pike, G.E.; Seager, C.H.; Dosch, R.G. (Sandia National Labs., Albuquerque, NM (US)). pp 409-414 of Microscopic identification of electronic defects in semiconductors. Johnson, N.M.; Bishop, S.G.; Watkins, G.D. Pittsburgh, PA; Materials Research Society (1985). (CONF-850421—).

From 2. spring meeting of the Materials Research Society; San Francisco, CA, USA (15 Apr 1985).

ZnO varistors are polycrystalline materials which have highly non-linear current/voltage characteristics controlled by depletion regions around the grain boundaries. Dissolved transition metals at concentrations of about 1 at.% are required to achieve this large nonlinearity, but their role is unclear. To address this issue the authors have used the technique of photothermal deflection spectroscopy to measure the optical absorption of varistors containing Co or Mn, both common dopants. Prominent peaks and edges appear in the spectra and are associated with substitutional Co/sup 2+/ and Mn/sup 2+/ ions whose ground states are deep within the ZnO bandgap. Electro- and photo-luminescence spectra show Stokes shifted peaks for some of these transitions. The spectral dependence of the photoconductivity shows that some of the absorption features correspond to ionization of the impurities. This result is used to show how the dark impact ionization of these impurities due to a high applied voltage can contribute to the current/voltage nonlinearity.

47207 **Dangling bonds and sub-gap optical absorption in silicon.** Seager, C.H.; Lenahan, P.M.; Brower, K.L.; Mikawa, R.E. (Sandia National Labs., Albuquerque, NM (US)). pp 539-544 of Microscopic identification of electronic defects in semiconductors. Johnson, N.M.; Bishop, S.G.; Watkins, G.D. Pittsburgh, PA; Materials Research Society (1985). (CONF-850421—).

From 2. spring meeting of the Materials Research Society; San Francisco, CA, USA (15 Apr 1985).

The silicon "dangling bond" defect plays a large part in controlling the electronic properties of a-Si, polycrystalline silicon, and the Si/SiO/sub 2/ interface. Jackson et al. have suggested that transitions of electrons occupying this defect produce the Urbach-like sub-gap absorption tail seen in two of these materials. The authors have performed optical and electron spin resonance measurements on polycrystalline silicon, plastically deformed silicon, and Si/SiO/sub 2/ interfaces to further examine this contention. In addition to seeing no measurable absorptance due to dangling bond interface states in the latter system, the authors conclude from the poor correlation of ESR signals with optical data that the Urbach tail in polycrystalline and deformed silicon is not due to transitions of dangling bond electrons.

47208 **The identification of lattice defects in GaAs and AlGaAs.** Weber, E.R. (Dept. of Materials Science and Mineral Engineering, and Center for Advanced Materials, Lawrence Berkeley Lab., Univ. of California, Berkeley, CA (US)). pp 169-178 of Microscopic identification of electronic defects in semiconductors. Johnson, N.M.; Bishop, S.G.; Watkins, G.D. Pittsburgh, PA; Materials Research Society (1985). (CONF-850421—).

From 2. spring meeting of the Materials Research Society; San Francisco, CA, USA (15 Apr 1985).

Anion antisite defects are the first convincingly identified intrinsic lattice defect in GaAs. Photo-EPR allowed to determine the energy levels of this double donor, with the single donor level being midgap. This level appears to be very similar to the technologically important "EL2" center in GaAs. However, various evidence indicates that EL2 is not due to ideal, undistorted antisite defects. Fermi level pinning at Schottky contacts on GaAs has been

ascribed to intrinsic lattice defects. Antisite defects are a likely candidate for this process. Finally, the microscopic identity of the "DX" center in AlGaAs is discussed. This defect has been generally identified with a complex of a donor atom and an unknown partner. A number of recent experimental observations indicate that this defect might rather be due to isolated donors, which get deep levels because of the change of bandstructure in the alloy system.

47209 **Thermal donor removal by rapid thermal annealing: Infrared absorption.** Stein, H.J.; Hahn, S.K.; Shatas, S. (Sandia National Labs., P.O. Box 5800, Albuquerque, NM (US)). pp 269-274 of Microscopic identification of electronic defects in semiconductors. Johnson, N.M.; Bishop, S.G.; Watkins, G.D. Pittsburgh, PA; Materials Research Society (1985). (CONF-850421—).

From 2. spring meeting of the Materials Research Society; San Francisco, CA, USA (15 Apr 1985).

Rapid thermal annealing of thermal donors in Si with 10 sec anneal times at temperatures between 600 and 1000°C has been investigated by infrared absorption at 80 K. Thermal donors A through D, which are identified by excited state absorption, are present in as-grown Czochralski Si; whereas excited states for donors A through F as well as photoionization of thermal donors are observed after extended heating at 450°C. The temperature required for rapid thermal annealing is lower when only donors A through D are present. Removal of thermal donors A through F by rapid thermal annealing at temperatures > 800°C restores 7 to 8 oxygen atoms to interstitial sites per electrically measured donor removed. This ratio supports oxygen cluster models for thermal donors but does not support previous suggestions that such clusters are embryonic forms of high temperature oxygen precipitates.

4209 Waste Processing Plants And Equipment

REFER ALSO TO CITATION(S) 46478

4210 Combustion Systems

REFER ALSO TO CITATION(S) 46257, 46833, 46835, 46836, 46838, 46839, 47181

47210 **(LA—11353-SOP) Standard operating procedure: Gas atmosphere MELCO brazing furnace.** Waller, C.R. (Los Alamos National Lab., NM (USA)). Aug 1988. Contract W-7405-ENG-36. 41p. NTIS, PC A03/MF A01; 1; GPO Dep. Order Number DE88014014/JAW.

A hydrogen and argon gas atmosphere furnace facility using electric furnaces is located at the Clinton P. Anderson Meson Physics Facility (LAMPF). This furnace system was acquired to handle smaller jobs with a more rapid response time than was possible with the larger furnaces. Accelerator- and experimental-related components best assembled by atmosphere brazing techniques are routinely processed by this facility in addition to special heat treatment and bakeout heats. The detailed operation sequence and description of the MELCO furnace system are covered by this report. This document is to augment LA-10231-SOP, which describes the operation of the large furnace systems. 6 figs.

47211 **(N—88-22382) Lewis structures technology, 1988. Volume 2: structural mechanics.** (National Aeronautics and Space Administration, Cleveland, OH (USA). Lewis Research Center). May 1988. vp. (NASA-CP—3003-VOL-2; E—3970-VOL-2; NAS—1.55:3003-VOL-2; CONF-8805178—). NTIS, PC A14/MF A01.

From Lewis structures technology symposium; Cleveland, OH, USA (24 May 1988).

Lewis Structures Div. performs and disseminates results of research conducted in support of aerospace engine structures. These results have a wide range of applicability to practitioners of structural engineering mechanics beyond the aerospace arena. The engineering community was familiarized with the depth and range of research performed by the division and its academic and industrial partners. Sessions covered vibration control, fracture mechanics, ceramic component reliability, parallel computing, nondestructive evaluation, constitutive models and experimental capabilities, dynamic systems, fatigue and damage, wind turbines, hot section technology (HOST), aeroelasticity, structural mechanics codes, computational methods for dynamics, structural optimization, and applications of structural dynamics, and structural mechanics computer codes.

47212 **(N—88-22382, pp vp) Specialty three-dimensional finite element analysis codes.** Lackney, J.J. May 1988. NTIS, PC A14/MF A01. (NASA-CP—3003-VOL-2; E—3970-VOL-2; NAS—1.55:3003-VOL-2; CONF-8805178—).

From Lewis structures technology symposium; Cleveland, OH, USA (24 May 1988).

General purpose finite element computer codes that can model inelastic material behavior have been available for more than a decade. However, these codes have not been accurate enough for use in analyzing hot section engine components. To correct this problem, General Electric developed a series of nine new stand-alone computer codes for NASA. Because of the large temperature excursions associated with hot section engine components, these codes have been designed to accommodate broad variations in material behavior, including plasticity and creep. The capabilities of these computer codes are summarized.

47213 **(N—88-22382, pp vp) Structural tailoring of high-speed turbine blades (SSME/STAEBL).** Rubinstein, R. May 1988. NTIS, PC A14/MF A01. (NASA-CP—3003-VOL-2; E—3970-VOL-2; NAS—1.55:3003-VOL-2; CONF-8805178—).

From Lewis structures technology symposium; Cleveland, OH, USA (24 May 1988).

Space shuttle main engine (SSME) blades are subject to severe thermal, pressure, and forced vibration environments. Structural optimization provides an automated alternative to time consuming iterations. Any number of analyses, design variables, and constraints can be incorporated in a structural optimization computer code. This idea was applied to develop the code SSME/STAEBL, which is a stand alone code suitable for automated design of SSME turbopump blades. Additions and modifications of STAEBL included in SSME/STAEBL include the following: (1) thermal stress analysis, (2) gas dynamic (pressure) loads, (3) temperature-dependent material and thermal properties, (4) forced vibrations, (5) tip displacement constraints, (6) single crystal material analysis, (7) blade cross-section stacking offsets, and (8) direct time integration algorithm for transient dynamic response.

47214 **(N—88-22382, pp vp) Thermal-structural analyses of Space Shuttle Main Engine (SSME) hot section components.** Abdul-Aziz, A.; Thompson, R.L. (Sverdrup Technology, Inc., Cleveland, OH (USA)). May 1988. NTIS, PC A14/MF A01. (NASA-CP—3003-VOL-2; E—3970-VOL-2; NAS—1.55:3003-VOL-2; CONF-8805178—).

From Lewis structures technology symposium; Cleveland, OH, USA (24 May 1988).

Three dimensional nonlinear finite element heat transfer and structural analyses were performed for the first stage high pressure fuel turbopump (HPFTP) blade of the space shuttle main engine (SSME). Directionally solidified (DS) MAR-M 246 and single crystal (SC) PWA-1480 material properties were used for the analyses. Analytical conditions were based on a typical test stand engine cycle. Blade temperature and stress strain histories were calculated by using the MARC finite element computer code. The structural response of an SSME turbine blade was assessed and a greater understanding of blade damage mechanisms, convective cooling effects, and thermal mechanical effects was gained.

47215 **(N—88-22408) Lewis structures technology, 1988. Volume 3: structural integrity fatigue and fracture wind turbines HOST.** (National Aeronautics and Space Administration, Cleveland, OH (USA). Lewis Research Center). May 1988. vp. (NASA-CP—3003-VOL-3; E—3970-VOL-3; NAS—1.55:3003-VOL-3; CONF-8805178—). NTIS, PC A16/MF A01.

From Lewis structures technology symposium; Cleveland, OH, USA (24 May 1988).

The charter of the Structures Division is to perform and disseminate results of research conducted in support of aerospace

engine structures. These results have a wide range of applicability to practioners of structural engineering mechanics beyond the aerospace arena. The specific purpose of the symposium was to familiarize the engineering structures community with the depth and range of research performed by the division and its academic and industrial partners. Sessions covered vibration control, fracture mechanics, ceramic component reliability, parallel computing, nondestructive evaluation, constitutive models and experimental capabilities, dynamic systems, fatigue and damage, wind turbines, hot section technology (HOST), aeroelasticity, structural mechanics codes, computational methods for dynamics, structural optimization, and applications of structural dynamics, and structural mechanics computer codes.

4230 Marine Engineering

47216 **(AUC-IBT-R—8801) Discrete analysis of a plane initial-value problem for an offshore structure.** Szmidt, J.K. (Aalborg Universitetscenter (Denmark). Inst. for Bygningsteknik). Jan 1988. 58p. Available on loan from Risoe Library, DK-4000 Roskilde.

Structural reliability theory. Paper 37.

Offshore structures are generally subjected to hydrodynamic sea forces, wind forces and sea-bed forces. The quantities such as compression forces, velocities and displacements of a structure etc. are of random nature and they are more or less corelated to each other. The general problem of describing structure-fluidpinteraction is a difficult task, even in the case of deterministic formulation and harmonic vibration of the structure. The aim of the present work is to solve the initial moving wall problem for a layer of fluid with the help of the finite difference method. Special attention will be paid to the explanation of singularity in the velocity field which results from approximation to the mathematical desription of the phenomenon rather than from physical baxkground. We will also discuss some properties of algebraic equations resulting from the method of solving the problem. In the following we apply some necessary approximations and we consider some auxiliary problems which will hopefully finally result in the solution we are looking for. 11 refs.

47217 **(DTH-DCAMM—360) Upheaval creep of buried heated pipelines with initial imperfections.** Terndrup Pedersen, P.; Juncher Jensen, J. (Danmarks Tekniske Hoejskole, Lyngby. Inst. for Skibs- og Havteknik). Oct 1987. 22p. NTIS (US Sales Only), PC A03/MF A01. Order Number DE88754065/JAW.

Based on a study of the soil-pipeline interaction a new design procedure is presented for heated marine pipelines buried in the seabed. It has been observed that geometric imperfections in buried heated pipelines can increase in size with time such that the compressive stresses induced due to thermal expansion and internal pressure can lead to vertical buckling of the pipeline. In the present paper a consistent theory is developed for analysis of imperfect, heated pipelines. It is shown that the observed gradual upheaval can be caused by temperature fluctuations in combination with initial imperfections of the pipeline. For a given pipeline temperature and burial depth the mathematical model can be used to impose restrictions on the allowable imperfections of the unloaded pipe centre line (plastic deformations) combined with restrictions on the allowable imperfections of the trench.

47218 (NEI-NO—44, pp 151-160) **Diverless surface-independent subsea intervention.** Garlung, W. (TTS Technology A/S, Bergen (Norway)). 1986. NTIS (US Sales Only), PC A24. Order Number DE88753699/JAW. (CONF-860481—).

From Underwater technology conference; Bergen, Norway (14 Apr 1986).

This paper presents the integrated surface independent subsea intervention system - Sisis- for subsea production installations and pipelines. Topics covered include: a manned autonomous load- carrying submarines with robotic work systems; an integrated template manifold concept for intervention by the submarine; a diverless emergency pipeline repair system for deep waters.

4240 Pollution Control Equipment

REFER ALSO TO CITATION(S) 46739, 47295, 47302

4250 Power Cycles

REFER ALSO TO CITATION(S) 46715, 46717, 46718

47219 **(CONF-8804100—13) Integration of analysis and experiment for Stirling cycle processes: Part 1, Gas spring hysteresis loss.** Kornhauser, A.A.; Smith, J.L. Jr. (Massachusetts Inst. of Tech., Cambridge (USA)). 1988. Contract AC05-84OR21400. 7p. NTIS, PC A02. Order Number DE88013202/JAW.

From 2. DOE/ORNL heat pump conference: research and development on the heat pump for space conditioning applications; Washington, DC, USA (17 Apr 1988).

Heat transfer-related hysteresis loss can be an important factor in the performance of Stirling and other reciprocating machines. Analytical predictions of hysteresis loss have been available to designers, but until now they were not experimentally verified. Hysteresis loss was measured in a piston-cylinder gas spring over a range of speeds, pressures, gases, bore/stroke ratios, volume ratios, and internal extended surface geometries. An analysis of a simplified one-dimensional energy equation produced non-dimensional parameters that were used to correlate the experimental data. The loss expression from the analysis was adjusted to fit the correlated data. 7 refs., 8 figs.

43 PARTICLE ACCELERATORS

47220 **(PB—88-210547/XAB) Ground-water investigations for siting the Superconducting Super Collider in northeastern Illinois.** Visocky, A.P.; Schulmeister, M.K. (Illinois State Water Survey, Champaign (USA)). 1988. 87p. (ISWS/CIRC—170/88). NTIS, PC A05/MF A01.

The Superconducting Super Collider (SSC) study area comprises 36 townships in Kane County and portions of Cook, DeKalb, DuPage, Kendall, and Will Counties. An inventory and mass measurement of water levels in 389 private domestic wells was conducted during the summer of 1986. Potentiometric surface maps constructed from these data indicate that the general direction of ground-water movement is to the southeast and toward cones of depression resulting from subdivision pumpage in north-central Kane County. Monthly water-level measurements have been made since December 1984 at 26 individual piezometers and at nine nested piezometers. The data show that vertical head gradients of from 0.14 to 3.35 feet per foot exist between various aquifers. An analysis of water samples indicate that the ground water likely to be encountered at the SSC site is a calcium-magnesium bicarbonate.

4301 Design, Development, And Operation

REFER ALSO TO CITATION(S) 47121, 47166

47221 **(ANL/EES-TM—347) Technical assessment of environmental and cost implications of superconducting super collider decommissioning.** Chen, S.Y.; Opelka, J.H.; Chambers, W.C.; Stavrou, J. (Argonne National Lab., IL (USA)). Jul 1988. Contract W-31109-ENG-38. 59p. NTIS, PC A04/MF A01; 1; GPO Dep. Order Number DE88015065/JAW.

Potential environmental and cost implications of decommissioning the proposed Superconducting Super Collider (SSC) are examined. One decommissioning alternative is selected for general assessment. That alternative includes removal of the major sources of radioactivity induced during operation and temporary entombment of remaining underground facilities. On the suface, the campus complex would be left in place for future use, but most other aboveground features would be dismantled and removed. Because of the low level of radioactivity that would be induced in SSC components during system operation, potential radiological impacts to the environment from decommissioning would be benign, and

the estimated total occupational radiation dose to workers would be less that 5 person-rem. Potential nonradiological impacts of decommissioning are not evaluated because of the lack of site-specific data. The total estimated cost of decommissioning operations is $38 million. Although few current regulations are explicitly applicable, the SSC decommissioning operation should not encounter any difficulty in complying with potentially applicable regulatory constraints. Upon completion of decommissioning, the SSC site surface could be returned to unrestricted use, but it is recommended that a degree of institutional control and environmental monitoring be carried out for a short period following decommissioning. 11 refs., 8 figs., 6 tabs.

47222 **(DOE/ER/30024—T1) Advanced accelerators.** Callan, C.; Max, C.; Perkins, F.; Rosenbluth, M. (Mitre Corp., McLean, VA (USA). Jason Program Office). Apr 1988. Contract AI01-82ER30024. 112p. (JSR—85-302). NTIS, PC A06/MF A01; 1; GPO Dep. Order Number DE88013483/JAW.

This report discusses the suitability of four novel particle acceleration technologies for multi-TeV particle physics machines: laser driven linear accelerators (linac), plasma beat-wave devices, plasma wakefield devices, and switched power and cavity wakefield linacs. The report begins with the derivation of beam parameters practical for multi-TeV devices. Electromagnetic field breakdown of materials is reviewed. The two-beam accelerator scheme for using a free electron laser as the driver is discussed. The options recommended and the conclusions reached reflect the importance of cost. We recommend that more effort be invested in achieving a self-consistent range of TeV accelerator design parameters. Beat-wave devices have promise for 1-100 GeV applications and, while not directly scalable to TeV designs, the current generation of ideas are encouraging for the TeV regime. In particular, surfatrons, finite-angle optical mixing devices, plasma grating accelerator, and the Raman forward cascade schemes all deserve more complete analysis. The exploitation of standard linac geometry operated in an unconventional mode is in a phase of rapid evolution. While conceptual projects abound, there are no complete designs. We recommend that a fraction of sponsored research be devoted to this approach. Wakefield devices offer a great deal of potential; trades among their benefits and constraints are derived and discussed herein. The study of field limitation processes has received inadequate attention; this limits experiment designers. The costs of future experiments are such that investment in understanding these processes is prudent. 34 refs., 12 figs., 3 tabs.

47223 **(LA-UR—88-1546) PARMTEQ [Phase And Radial Motion in Transverse Electric Quadrupole linacs]: A beam dynamics code for the RFQ [radio-frequency quadrupole].** Crandall, K.R.; Wangler, T.P. (Los Alamos National Lab., NM (USA)). 1987. Contract W-7405-ENG-36. 8p. (CONF-8701132—1). NTIS, PC A02/MF A01; 1; GPO Dep. Order Number DE88011051/JAW.

From Workshop on linear accelerator and beam optics codes; San Diego, CA, USA (19 Jan 1987).

The PARMTEQ code is used for generating the complete cell design of a radio-frequency quadrupole linear accelerator and for multiparticle simulation of the beam dynamics. We present a review of the code, with an emphasis on the physics used to describe the particle motion and the cell generation. 9 refs., 1 fig.

47224 **(TRI-PP—88-15) Status of the TRIUMF Kaon Factory proposal.** Craddock, M.K. (TRIUMF, Vancouver, British Columbia (Canada)). Mar 1988. 3p. (CONF-880263—11). NTIS (US Sales Only), PC A02. Order Number DE88013261/JAW.

From Accelerator design workshop; Los Alamos, NM, USA (22 Feb 1988).

Over the last year considerable progress has been achieved on both technical and political fronts. Hardware studies have continued on both magnet power supplies and on rf cavities — the latter work gaining an extra dimension from a recently-instituted formal collaboration with LAMPF. A racetrack-shaped lattice is being considered in conjunction with a three-element slow extraction system in an effort to reduce losses to the 0.1% level. British Columbia has agreed to fund the buildings and tunnels (Cdn $87M) and is making the KAON Factory its top priority project with the Canadian federal government. A joint federal-provincial delegation has traveled abroad and found that a number of countries would consider significant contributions to the cost. Government approval contingent upon such contributions is anticipated later in 1988, together with preconstruction R&D funds. 10 refs., 4 figs.

4302 Beam Dynamics, Field Calculations, And Ion Optics

REFER ALSO TO CITATION(S) 47223, 47245, 47254, 47257, 47566

47225 **(AD-A—192452/1/XAB) Optical guiding in the separable beam limit.** Antonsen, T.M.; Levush, B. (Maryland Univ., College Park (USA). Lab. for Plasma and Fusion Energy Studies). Sep 1987. 12p. (UMLPF—88-011). NTIS, PC A03/MF A01.

The nonlinear theory of optical guiding in a free-electron-laser amplifier is developed for the case in which the spatial dependence of the current source term in the wave equation can be separated into the product of a function of radius and a function of axial distance. Such a separation can be motivated if either the betatron wavelength is shorter than other lengths of interest (synchrotron wavelength, vacuum Rayleigh length) or if the radiation waist exceeds the beam radius. In this limit with the choice of a Gaussian profile for the electron-beam density, the wave equation can be solved exactly and the radiation field felt by the particles can be expressed as a one-dimensional convolution of the current source. With the given expression for the radiation field, the equations of motion can be solved in the trapped particle regime. Requiring consistency between the particle motion and the fields yields expressions describing nonlinear guided states. The adiabatic evolution of these guided states in the presence of a tapered wiggler is determined by conservation of the electrons action and total (field + electron beam) energy. Using these relations the growth of the radiation waist as the beam is decelerated can be calculated.

47226 **(FNAL/C—88/80) Luminosity lifetime in the Tevatron.** Jackson, G.; Finley, D.; Johnson, R.P.; Kerns, Q.; McCarthy, J.; Siemann, R.; Zhang, P. (Fermi National Accelerator Lab., Batavia, IL (USA)). 9 Jun 1988. Contract AC02-76CH03000. 3p. (CONF-880695—46). NTIS, PC A02. Order Number DE88014110/JAW.

From 1. European particle accelerator conference; Rome, Italy (7 Jun 1988).

Since the inauguration of colliding proton-antiproton operations in 1987, the Tevatron has exhibited luminosity lifetimes shorter than expected. During a typical colliding beam storage period, called a store, luminosity is calculated periodically by measuring the charge and emittances of each bunch. The growth of the transverse bunch emittances is the dominant cause of luminosity deterioration. Throughout, this period, the position spectrum of the bunches exhibited betatron signals larger than expected from Schottky noise. A model assuming externally driven betatron oscillations explains both the betatron signals and the emittance growth. A program is underway to improve the Tevatron luminosity lifetime. The abort kickers have been identified as sources of emittance growth, and some quadrupole power supplies are further candidates. Because the horizontal dispersion through the RF cavities is nonzero, RF phase noise has been investigated. Noise in the main dipole regulation circuit has also been studied. 13 refs., 4 figs.

47227 **(FNAL-TM—1532) On the calibration of TEVATRON beam position and intensity monitors used in E778.** Merminga, L.; Gerig, R.; Peggs, S. (Fermi National Accelerator Lab., Batavia, IL (USA)). May 1988. Contract AC02-76CH03000. 12p. NTIS, PC A03. Order Number DE88015526/JAW.

In the second run of E778 two sets of electronics were used to record the motion of the center of mass of the beam. The first, the standard Fermilab Beam Position Monitor (BPM) front end, gives direct horizontal, vertical and intensity signals. The second is a peak sensing circuit which gives signals from the separate plates of two horizontal and one vertical pickup. This note addresses the question of calibration of the signals from the standard Tevatron beam position (HF42 and HF44 in the case of E778) and intensity

monitors (I-45). Following is the summary of this study: Calibration Constants {minus} Position Monitors = .0083 mm/mV; Smear data = {minus}147 LSB/10^{10} particles; Resonance island data = ({minus}134 +- 7) LSB/10^{10} particles. 6 figs.

47228 **(INIS-BR—1177) Specification of electron beam quality from ionization distribution in central axis and a study about heterogenity effects in these distributions.** Fernandes, R.F. (Sao Paulo Univ., Sao Carlos, SP (Brazil). Inst. de Fisica e Quimica). 1984. 163p. (In Portuguese). NTIS (US Sales Only), PC A08/MF A01. Order Number DE88703870/JAW.

Some parameters on physical and terapeutic properties of the electron beams generated by "nevratron XII" accelerator of the Hospital of Medicine in Ribeirao Preto - USP, Brasil are evaluated. The effects from heterogenities into an irradiated mean, called "phantom" or simulator are studied. (M.J.C.).

47229 **(LA-UR—88-1562) Summary for the working group on linac codes.** Wangler, T.P.; Staples, J. (Los Alamos National Lab., NM (USA); Lawrence Berkeley Lab., CA (USA)). 1988. Contract W-7405-ENG-36. 5p. (CONF-880178—9). NTIS, PC A02/MF A01; 1; GPO Dep. Order Number DE88013743/JAW.

From Workshop on accelerator and beam optics codes; San Diego, CA, USA (19 Jan 1988).

The linac codes group discussed two main topics: the PARMTEQ codes and their environment and limitations of the linac simulation codes. These topics are contained in this paper. 7 refs.

47230 **(LBL—25334) Summary of working group on collective instabilities.** Zisman, M.S. (Lawrence Berkeley Lab., CA (USA)). May 1988. Contract AC03-76SF00098. 18p. (CONF-880335—8). NTIS, PC A03/MF A01; 1; GPO Dep. Order Number DE88014868/JAW.

From Workshop on the relativistic heavy ion collider performance; Upton, NY, USA (21 Mar 1988).

In this paper we summarize the efforts of the Working Group on Collective Instabilities at the Workshop on the RHIC Performance. Impedance estimates have been made for some of the main hardware in RHIC, including bellows, pickup electrodes, abort kicker, and transverse damper. In general, these impedances are not expected to limit the beam intensity for Au ions, but might limit the proton intensity. We have also calculated the higher-order modes of the standard 26.7-MHz rf cavity for use in estimating coupled-bunch instability growth rates. Predictions of intrabeam scattering confirm the results in the RHIC Conceptual Design Report. For the standard assumptions, there is a threefold growth in transverse emittance. Varying the initial transverse emittance by a factor of two changes the final emittance value (after 10 hours) by less than 20%. If a 214-MHz rf system is considered, the growth is more severe—about a factor of five—and a beam lifetime of 10 hours requires an rf voltage in excess of 32 MV. Coupled-bunch calculations show that the transverse instabilities are dominated by the resistive-wall impedance for either rf choice. A modest damping system should be adequate to deal with this. Longitudinal growth times of about 20 ms are expected for the low-frequency rf case; growth times for the high-frequency rf system are a factor of 10 longer and the instability is predicted to be Landau damped. Copper plating of the dipole vacuum chambers has been found to have no deleterious effects, provided the coating is uniform and not overly thick. 14 refs., 3 tabs.

47231 **(TRI-PP—88-14) Polarization in the new racetrack driver ring of the TRIUMF KAON Factory.** Wienands, U. (TRIUMF, Vancouver, British Columbia (Canada)). Mar 1988. 3p. (CONF-880263—12). NTIS (US Sales Only), PC A02; 1; GPO Dep. Order Number DE88013260/JAW.

From Accelerator design workshop; Los Alamos, NM, USA (22 Feb 1988).

The number and strength of the intrinsic depolarizing resonances in the new racetrack lattice for the TRIUMF KAON Factory Driver ring have been calculated. For the twofold symmetric lattice, a high number of resonances was expected, but only a few resonances were found to have great strength. These can be explained as structural depolarizing resonances of the arcs. If the straight sections are retuned to be unit sections in the vertical plane and thus to be transparent to spin and vertical betatron motion, most resonances disappear and only 9 resonances remain, belonging to the twelvefold symmetry of the arcs. Most of these resonances are weak or only of moderate strength and can be jumped efficiently. The resonances arising from the 48-fold symmetry are very strong, allowing the spin to be flipped and more that 90% of the polarization to be preserved. Total depolarization up to 30 GeV due to intrinsic resonances is less than 20% if pulsed quadrupoles are used to jump the moderately strong resonances. 4 refs., 3 figs., 1 tab.

47232 **(TRI-PP—88-36) Space charge neutralization studies of an H/sup minus/ beam.** Baartman, R.; Yuan, D. (TRIUMF, Vancouver, British Columbia (Canada)). Jun 1988. 2p. (CONF-880695—40). NTIS (US Sales Only), PC A02; 1; GPO Dep. Order Number DE88013256/JAW.

From 1. European particle accelerator conference; Rome, Italy (7 Jun 1988).

We have used a 1 mA cw H{sup{minus -}} beam from the TRIUMF cusp source to study space charge neutralization at 12 keV as a function of the pressure of the background H_2 gas. At 10{sup{minus}6} Torr the neutralization level was found to be 96% with a time constant of 80 μs. At 10{sup{minus}4} Torr there is possibly slight overcompensation (100.7%+-0.4%) and the time constant was found to be 4 μs. We discuss these results and explain them qualitatively. 5 refs., 5 figs., 1 tab.

47233 **(TRI-PP—88-41) The LONG1D simulation code.** Koscielniak, S.R. (TRIUMF, Vancouver, British Columbia (Canada)). Jun 1988. 3p. (CONF-880695—35). NTIS (US Sales Only), PC A02. Order Number DE88013272/JAW.

From 1. European particle accelerator conference; Rome, Italy (7 Jun 1988).

LONG1D is a tracking programme for the study of longitudinal dynamics in proton synchrotrons, in the presence of space charge. The model only considers motion along the beam axis. The beam is represented by an ensemble of macro-particles, tracked in parallel. LONG1D has a variety of ensembles available, as appropriate to coasting and bunched beams. It allows for the injection of additional particles, to facilitate phase-space painting studies. LONG1D can simulate the effect of radial and phase damping loops, and provides estimates of transverse incoherent betatron tune-shifts, This paper presents the physics algorithms used and some simulation results, and comparison with experimental observations. 10 refs., 2 figs.

47234 **Field-gradient effect in quantum beamstrahlung.** Chen, P.; Yokoya, K. (Stanford Linear Accelerator Center, Stanford University, Stanford, California 94309). *Physical Review Letters;* 61: No. 9, 1101-1104(29 Aug 1988).

The correction terms to the Sokolov-Ternov radiation formula due to variation of the magnetic field strength along the electron trajectory are calculated up to the second order in the power expansion of B-italic-dottau/B, where tau is the formation time of radiation. It is found that the field-gradient effect reduces radiation intensity in the classical regime, and enhances it in the quantum regime. This is then applied to quantum beamstrahlung with Gaussian variation in e^+e^- bunch currents. The correction is shown to be substantial for beam parameters suggested by Himel and Siegrest.

47235 **Cumulative beam break-up in a periodic linac.** Decker, G.; Wang, J. (National Synchrotron Light Source, Brookhaven National Laboratory, Upton, New York 11973). *Physical Review* [*Section*] *D: Particles and Fields;* 38: No. 3, 980-986(1 Aug 1988).

The problem of cumulative beam break-up for a coasting beam in a linac with periodically placed acceleration cavities and transverse focusing units is treated using a general technique. The equations of motion for a series of equally spaced pointlike bunches are reduced to a single Hill's-type differential equation, from which a transfer matrix for a single period is derived. The technique is applied to the special case of a single resonance impedance, yielding a

result which is in agreement with that derived elsewhere. The case of two nearly degenerate resonances is investigated using saddle-point integration, in the limit of strong focusing.

47236 Metallurgical examination of the LAMPF beam stop. Brown, R.D.; Cook, J.H.; Romero, T.J. (Los Alamos National Lab., NM (USA)). *Transactions of the American Nuclear Society;* **55**: 265(1987). (CONF-8711195—).

From American Nuclear Society winter meeting; Los Angeles, CA, USA (15 Nov 1987).

The Clinton P. Anderson Los Alamos Meson Physics Facility (LAMPF) provides physicists with 800-MeV protons and secondary particles with which to perform nuclear physics and other experiments. The secondary particles are generated by the interaction of the proton beam with graphite targets in the experimental area. Passage through these targets and those of the isotope production facility reduces the proton energy to ~ 500 MeV and spreads the beam out. At the face of the beam stop, the beam is believed to have a roughly Gaussian profile, with a full-width at half-maximum of ~ 60 mm. Allowing for beam attenuation in upstream targets, the power deposition in the beam stop is ~ 375 kW. In this paper, we report the results of metallographic examination of a beam stop that was used at LAMPF for ~ 3 yr. Examination of the copper plates and the Alloy 718 front plate shows that while both materials have become less ductile, only the copper plates have been sufficiently embrittled (along the grain boundaries) to lead to the breakup of the plates. The integrity of the beam stop system depends primarily on the condition of the front plate, which is the area of the pressure vessel most exposed to radiation damage. The tensile properties of the Alloy 718 sample tested indicate that the front plant of the beam stop should remain intact at similar proton doses. At present beam currents, this requires replacement of the beam stop approximately every 2 yr.

4303 Auxiliaries And Components

REFER ALSO TO CITATION(S) 47163, 47227, 47255, 47992

47237 (FNAL-TM—1530) Technical manual for calculating cooling pond performance. Krstulovich, S.F. (Fermi National Accelerator Lab., Batavia, IL (USA)). 1 Jul 1988. Contract AC02-76CH03000. 72p. NTIS, PC A05. Order Number DE88014108/JAW.

This manual is produced in response to a growing number of requests for a technical aid to explain methods for simulating cooling pond performance. As such, it is a compilation of reports, charts and graphs developed through the years for use in analyzing situations. Section II contains a report summarizing the factors affecting cooling pond performance and lists statistical parameters used in developing performance simulations. Section III contains the graphs of simulated cooling pond performance on an hourly basis for various combinations of criteria (wind, solar, depth, air temperature and humidity) developed from the report in Section II. Section IV contains correspondence describing how to develop further data from the graphs in Section III, as well as mathematical models for the system of performance calculation. Section V contains the formulas used to simulate cooling pond performances in a cascade arrangement, such as the Fermilab Main Ring ponds. Section VI contains the calculations currently in use to evaluate the Main Ring pond performance based on current flows and Watts loadings. Section VII contains the overall site drawing of the Main Ring cooling ponds with thermal analysis and physical data.

47238 (JINR—9-87-495) Program for computing inhomogeneous coaxial resonators and accelerating systems of the U-400 and ITs-100 cyclotrons. Gul'bekyan, G.G.; Ivanov, Eh.L. (Joint Inst. for Nuclear Research, Dubna (USSR). Lab. of Nuclear Reactions). 1987. 9p. (In Russian). NTIS (US Sales Only), PC A02/MF A01. Order Number DE88703650/JAW.

The "Line" computer code for computing inhomogeneous coaxial resonators is described. The results obtained for the resonators of the U-400 cyclotron made it possible to increase the energy of accelerated ions up to 27 MeV/nucl. The computations fot eh ITs-100 cyclic implantator gave the opportunity to build a compact design with a low value of consumed RF power. 7 refs.; 5 figs.; 2 tabs.

47239 (JINR—R-9-87-457) System of programs for determination of cyclotron magnet parameters by the given dynamic characteristics of the beam. Vorozhtsov, S.B.; Kalinkina, M.B.; Saenko, V.A. (Joint Inst. for Nuclear Research, Dubna (USSR). Lab. of Nuclear Problems). 1987. 8p. (In Russian). NTIS (US Sales Only), PC A02/MF A01. Order Number DE88703756/JAW.

Submitted to the Organizing Comittee of Conference on electromagnetic field calculation, Graz, Austria, 25-28 Aug 1987.

A problem of determination of cyclotron magnet parameters by the given beam dynamic characteristics is considered. The calculation of the magnetic of spiral-sector and radial-sector cyclotrons is based on series of two-dimensional calculations at various cross sections of the magnet to be followed by reconstructions of the spatial map. The method is proposed to solve the inverse problem of determination of the magnet geometry for the given purpose functions. This can be achieved by the algorithm used in the program PISA. The program was checked by calculation of a spiral-sector cyclotron magnet. The state of the magnet core was held to be close to saturation. the developed program system allows to obtain a unique optimum solution for formation of required characteristics of the cyclotron magnet at the given set of parameters and values of weighting factors and the regularization vector. The program system can be used both for initial choice of cyclotron magnet parameters and for their correction at the facility under investigation. 17 refs.; 5 figs.; 1 tab.

47240 (JINR—R-11-87-732) Solution of two-dimensional integral magnetostatic equations using linear approximation of magnetization. Akishin, P.G.; Zhidkov, E.P.; Kravtsov, V.D. (Joint Inst. for Nuclear Research, Dubna (USSR). Lab. of Computing Techniques and Automation). 1987. 7p. (In Russian). NTIS (US Sales Only), PC A02/MF A01. Order Number DE88703774/JAW.

Solution of the two-dimensional integral magnetostatic equations using the piecewise linear approximation is considered. The approximated method for calculating the matrix coefficients of the discretized equations is proposed. A set of FORTRAN programs realizing this method is created. The results of test calculations are presented. 5 refs.; 2 figs.; 1 tab.

47241 (LA-UR—88-1826) The separation of control variables in an H/sup {minus}/ ion source. Bowling, P.S.; Brown, S.K. (Los Alamos National Lab., NM (USA)). 1988. Contract W-7405-ENG-36. 6p. (CONF-880695—48). NTIS, PC A02. Order Number DE88014458/JAW.

From 1. European particle accelerator conference; Rome, Italy (7 Jun 1988).

This paper describes a successful methodology which was used to classify a series if waveforms taken from a 100 ma H/sup {minus}/ ion source at Los Alamos. The series of 260 waveforms was divided into a "training" set and a "test" set. A sequence of mathematical transformations was performed on the "training" waveforms data and then it was subjected to discriminant analysis. The analysis generates a set of filters which will allow classification of an unknown waveform in the "test" set as being either stable or unstable; if stable, whether optimal or not; if not optimal, which of the six control parameters should be adjusted to bring it to an optimal condition. We have found that the probability of successful classification using this methodology is 91.5%. 3 refs., 4 figs., 2 tabs.

47242 (SLAC-PEP-NOTE—166) Polarization group coordinators summary. Lesvanis, L.K. (Stanford Linear Accelerator Center, Menlo Park, CA (USA)). 30 Aug 1974. Contract AC03-76SF00515. 4p. NTIS, PC A02/MF A01; 1; GPO Dep. Order Number DE88015166/JAW.

The magnitude and direction of the e^+, e/sup {minus}/ polarization are very important parameters at PEP. During the Summer Study many polarization monitors were considered together with methods for rotating and controlling the direction of polarization. 1 fig.

47243 **(SLAC-PUB—4663) Simulations of the laser photocathode injector.** Herrmannsfeldt, W.; Miller, R.; Hanerfeld, H. (Stanford Linear Accelerator Center, Menlo Park, CA (USA)). Jun 1988. Contract AC03-76SF00515. 5p. (CONF-880713—15). NTIS, PC A02/MF A01; 1; GPO Dep. Order Number DE88015337/JAW.

From 7. international conference on high-power particle beams; Karlsruhe, F.R. Germany (4 Jul 1988).

New, fully electromagnetic simulations of the beam optics in a laser-photocathode injector have been make using the PIC Code MASK. The recent studies are for the two-cavity design now undergoing tests by R. Sheffield, LANL. Pulses up to 10 nC are simulated, using cavities operating at 1300 MHz with above 1 MeV energy gain per cavity. The work is guided by previous simulation results which show that to achieve good agreement with the best experimental results, it is necessary to use very high RF fields near the cathode and to maintain small beam cross sections, corresponding to very high emission density.

47244 **(TRI-PP—88-13) Towards a slow extraction system for the TRIUMF Kaon Factory extender ring with 0.1% losses.** Wienands, U.; Servranckx, R.V. (TRIUMF, Vancouver, British Columbia (Canada); Saskatchewan Univ., Saskatoon (Canada)). Mar 1988. 6p. (CONF-880263—13). NTIS (US Sales Only), PC A02; 1; GPO Dep. Order Number DE88013259/JAW.

From Accelerator design workshop; Los Alamos, NM, USA (22 Feb 1988).

In order to reduce extraction losses a modified third-integral slow extraction system is proposed using a 0.5 m long and 10 μm thin electrostatic preseptum. Various factors limiting the extraction efficiency are investigated, and the losses are estimated to be as low as 0.2%. The extracted beam emittance is found to be about 0.2 π mm-mrad for achromatic extraction. For chromatic extraction a reduction in momentum width of the extracted beam by a factor of 2.5 will result in an extracted momentum bite of less than 30 MeV/c FWHM. This figure is limited by emittance blow-up due to synchrotron oscillations, which in turn increases extraction losses. Following the analytical estimate of the performance of the extraction system, simulation results are shown. 4 refs., 7 figs.

47245 **(TRI-PP—88-19) Instabilities group summary.** Baartman, R. (TRIUMF, Vancouver, British Columbia (Canada)). Mar 1988. 1p. (CONF-880263—14). NTIS (US Sales Only), PC A02; 1; GPO Dep. Order Number DE88013264/JAW.

From Accelerator design workshop; Los Alamos, NM, USA (22 Feb 1988).

The paper discusses the AHF compressor ring and the AHF kaon factory synchrotrons in terms of collective instabilities and beam loading; the observed fast transverse instability in the PSR, and progress in the development in the Los Alamos ceramic vacuum chamber. 3 refs.

47246 **(TRI-PP—88-22) Resonant magnet excitation at power.** Reiniger, K. (TRIUMF, Vancouver, British Columbia (Canada)). Mar 1988. 1p. (CONF-880263—15). NTIS (US Sales Only), PC A02; 1; GPO Dep. Order Number DE88013265/JAW.

From Accelerator design workshop; Los Alamos, NM, USA (22 Feb 1988).

This paper deals with experimental results obtained in high power tests of resonant magnet excitation which will lead to dual frequency resonant magnet excitation in the proposed TRIUMF KAON Factory. 3 figs., 1 tab.

47247 **(TRI-PP—88-35) Initial operating experience and recent development on the TRIUMF optically pumped polarized H /sup {minus}/ ion source.** Schmor, P.W.; Law, W.M.; Levy, C.D.P.; McDonald, M. (TRIUMF, Vancouver, British Columbia (Canada)). Jun 1988. 4p. (CONF-880695—41). NTIS (US Sales Only), PC A02; 1; GPO Dep. Order Number DE88013267/JAW.

From 1. European particle accelerator conference; Rome, Italy (7 Jun 1988).

A polarized H/sup {minus}/ ion source using optical pumping techniques has been developed at TRIUMF. This source was used to demonstrate (on an ion source test stand) the feasibility of producing 10 μA of (approximately)60% polarized H/sup {minus}/ ion beam in a dc mode suitable for injection into the TRIUMF cyclotron. The source has been installed in a 300 kV high voltage terminal connected to the cyclotron via a recently constructed beam transport line. A polarization of 80% is anticipated near the end of 1988 after the installation of a superconducting solenoid to the source. In this paper we describe the initial operating experience, recent developments, and the future plans for the TRIUMF optically pumped polarized ion source. 9 refs., 5 figs.

47248 **(TRI-PP—88-37) Matching of ion sources to cyclotron inflectors.** Baartman, R. (TRIUMF, Vancouver, British Columbia (Canada)). Jun 1988. 2p. (CONF-880695—39). NTIS (US Sales Only), PC A02; 1; GPO Dep. Order Number DE88013268/JAW.

From 1. European particle accelerator conference; Rome, Italy (7 Jun 1988).

In general, cyclotron inflectors strongly couple the transverse subspaces. This leads to a growth in emittance projections for a beam with no initial correlation between the two transverse subspaces. Only in the case of Mueller(hyperboloid) inflector is there no emittance growth. We have made calculations using an optimization routine to match a given beam through the axial magnetic field and inflector of a cyclotron axial injection system. We find that in the limit where all the emittance is due to a beam's axial angular momentum (for example, for an ECR source), matching with no emittance growth is possible even in the case of mirror or spiral inflectors. Moreover, any one of the two transverse emittances circulating in the cyclotron can be made smaller than the source emittance while maintaining the sum of the emittances constant. This is achieved by rotating the matching quadrupoles with respect to the inflector and retuning. 7 refs., 1 fig., 2 tabs.

47249 **(TRI-PP—88-38) A compact H /sup minus/ cyclotron for isotope production.** Schneider, H.R.; Baartman, R.; Laxdal, R.E.; Milton, B.F.; Otter, A.J.; Pearson, J.B.; Poirier, R.L.; Schmor, P.W. (TRIUMF, Vancouver, British Columbia (Canada)). Jun 1988. 3p. (CONF-880695—38). NTIS (US Sales Only), PC A02; 1; GPO Dep. Order Number DE88013269/JAW.

From 1. European particle accelerator conference; Rome, Italy (7 Jun 1988).

The design of a compact, high intensity H^- cyclotron for isotope production, exploiting the recently developed TRIUMF high brightness multicusp volume H/sup minus/ ion source, is describe. A 5 mA version of this H/sup minus/ source currently underdevelopment, makes possible accelerated beam intensities of up to 500 μA. the cyclotron has a four sector, radial ridge design, with two 45{degrees} dees in opposite valleys. Beam extraction is by stripping to H/sup plus/ in thin graphite foils. Two foil stripers permit the simultaneous extraction of two beams. By varying the radial position of the stripper the energy of the extracted beams can be varied between 15 MeV and 30 MeV. 7 refs., 5 figs., 1 tab.

47250 **(TRI-PP—88-42) Towards a slow extraction system for the TRIUMF Kaon Factory extender ring with 0.1% losses.** Wienands, U.; Servranckx, R.V. (TRIUMF, Vancouver, British Columbia (Canada)). Jun 1988. 3p. (CONF-880695—34). NTIS (US Sales Only), PC A02. Order Number DE88013273/JAW.

From 1. European particle accelerator conference; Rome, Italy (7 Jun 1988).

In order to reduce extraction losses a modified third-integral slow extraction system is proposed using a 0.5 m long and 10 μm thin electrostatic pre-septum. Various factors limiting the extraction efficiency like power-supply noise and synchrotron oscillations are investigated analytically as well as by simulation, and the losses are estimated to be as low as 0.2%. The extracted beam emittance is about 0. 2π mm-mrad. For chromatic extraction a reduction in momentum width of the extracted beam by a factor of 2.5, resulting in an extracted momentum bite of less than 30 MeV/c FWHM, can be achieved without emittance blowup. The duty factor typically is between 55% and 65%. Between 1.8% and 3.7% of the particles did not get extracted by the resonant system. First investigation of

half-integer extraction indicates possible difficulties in achieving small extracted emittances. 5 refs., 4 figs.

47251 (TRI-PP—88-43) Discrete helical spin rotators. Wienands, U. (TRIUMF, Vancouver, British Columbia (Canada)). Jun 1988. 3p. (CONF-880695—33). NTIS (US Sales Only), PC A02; 1; GPO Dep. Order Number DE88013274/JAW.

From 1. European particle accelerator conference; Rome, Italy (7 Jun 1988).

A family of multi-twist transverse-field spin rotators using tilted bending magnets is described that is useful for Siberian snakes as well as other spin rotators. The device has less orbit excursions than other designs found in the literature and, in applications in electron rings, exhibits less radiative depolarization for a given length of the spin rotator. A 3-twist snake and a 1-twist 90{degree} rotator are presented, the first for use in the proposed TRIUMF KAON factory and the second for possible use in an electron storage ring to achieve longitudinal polarization at the interaction point. Orbit errors and their correction are discussed. 8 refs., 4 figs., 3 tabs.

47252 (TRI-PP—88-44) Design of the 150 kW, 46-62 MHz power amplifier for the TRIUMF Kaon Factory booster ring. Kwiatkowski, S.; Enegren, T.; Poirier, R.L. (TRIUMF, Vancouver, British Columbia (Canada)). Jun 1988. 3p. (CONF-880695—32). NTIS (US Sales Only), PC A02; 1; GPO Dep. Order Number DE88013275/JAW.

From 1. European particle accelerator conference; Rome, Italy (7 Jun 1988).

The rf amplifiers for the Kaon Factory booster ring must be capable of reactively compensating (detuning) for the injected/extracted beam load as well as providing the beam power and the cavity losses. In order to insure the stability of the rf system under heavy transient and steady state beam loading conditions it is necessary to equip the power amplifiers with fast rf feedback with sufficient gain and bandwidth to reduce the apparent Q of the rf amplifier system as seen by the beam and the other feedback loops. The maximum gain and bandwidth of such a feedback loop is limited by the propagation delay a 2.4 kW two stage solid state driver will be used to drive the cathode of the Eimac Y567B tetrode to give an overall propagation delay less than 30 nS. The design features of the rf amplifier to meet the above conditions will be described and test results reported. 7 refs., 7 figs.

47253 (TRI-PP—88-46) Experimental results of high power dual frequency resonant magnet excitation at TRIUMF. Reiniger, K.W.; Heritier, G. (TRIUMF, Vancouver, British Columbia (Canada); European Organization for Nuclear Research, Geneva (Switzerland)). Jun 1988. 3p. (CONF-880695—30). NTIS (US Sales Only), PC A02; 1; GPO Dep. Order Number DE88013277/JAW.

From 1. European particle accelerator conference; Rome, Italy (7 Jun 1988).

We present some results of dual frequency resonant magnet excitation at full power using the old NINA synchrotron dipoles. These tests will simulate a typical resonant cell as proposed for the accelerating rings of the TRIUMF KAON Factory. These tests have two main purposes: to verify circuit parameters and component ratings for the dual frequency resonant power supply system; to directly measure electrical losses in a transverse magnet field, such as eddy current losses in magnet conductors, vacuum tubes and core losses in laminations. This data will be required for the detailed design of the accelerator system components. 1 ref., 9 figs., 1 tab.

4304 Storage Rings

47254 (LA-UR—88-1800) Status report on the Los Alamos proton storage ring. Colton, E.; Neuffer, D.; Thiessen, H.A.; Butler, H.; Swain, G.R.; Lombardi, A.; Fitzgerald, D.; Mariam, F.; Plum, M.; Ryder, R.; Macek, R.; Clark, D.; Hurd, C.J.; Hutson, R.; McGill, J.; Hardek, T.; Shafer, R.; Lawrence, G.; Jason, A.; Blind, B.; Hardekopf, R. (Los Alamos National Lab., NM (USA); European Organization for Nuclear Research, Geneva (Switzerland)). 1988. Contract W-7405-ENG-36. 7p. (CONF-8805142—9). NTIS, PC A02/MF A01; 1; GPO Dep. Order Number DE88014464/JAW.

From 3. international conference on the intersections between particle and nuclear physics; Rockport, ME, USA (14 May 1988).

The proton storage ring currently operates at an average current of 30 μA corresponding to 1.25 {times} 10^{13} protons per pulse (ppp) at a repetition rate of 15 Hz. The design operating current for the machine is 100 μA. We are limited to running at the reduced yield because of beam losses during the accumulation period. These losses are understood and arise mainly from emittance growths during the injection and multiple scattering in the stripping foil during the storage. During beam studies we have succeeded in accumulating in excess of 3.7 {times} 10^{13}ppp. We have also observed a coherent transverse instability at high charge levels. The signature for the instability is rapid coherent growth of the transverse beam size followed by a loss of beam in the machine. The threshold for the instability depends most strongly upon rf voltage and beam size. 3 refs., 1 fig., 1 tab.

47255 (SLAC-PEP-NOTE—113) The PEP injection system. Brown, K.L.; Avery, R.T.; Peterson, J.M. (Stanford Linear Accelerator Center, Menlo Park, CA (USA); Lawrence Berkeley Lab., CA (USA)). [1988]. Contract AC03-76SF00515. 4p. (SLAC-PUB—1553). NTIS, PC A02. Order Number DE88013373/JAW.

A system to transport 10-to-15-GeV electron and positron beams from the Stanford Linear Accelerator and to inject them into the PEP storage ring under a wide variety of lattice configurations has been designed. Optically, the transport line consists of three 360{degree} phase-shift sections of FODO lattice, with bending magnets interspersed in such a way as to provide achromaticity, convenience in energy and emittance definition, and independent tuning of the various optical parameters for matching into the ring. The last 360{degree} of phase shift has 88 milliradians of bend in a vertical plane and deposits the beam at the injection septum via a Lambertson magnet. Injection is accomplished by launching the beam with several centimeters of radial betatron amplitude in a fast bump provided by a triad of pulsed kicker magnets. Radiation damping reduces the collective amplitude quickly enough to allow injection at a high repetition rate.

47256 (SLAC-PEP-NOTE—151) A streamer chamber detector for PEP. Buschhorn, G.; Meyer, H.; Odian, A.; Yount, D. (Stanford Linear Accelerator Center, Menlo Park, CA (USA)). [1988]. Contract AC03-76SF00515. 9p. NTIS, PC A02/MF A01; GPO Dep. Order Number DE88014839/JAW.

A streamer chamber in an axial magnetic field is discussed as a possible central track detector around which additional detectors, such as shower counters, Cherenkov counters, time-of-flight counters, etc., can be assembled.

47257 (TRI-PP—88-18) Instabilities in PSR II. Baartman, R. (TRIUMF, Vancouver, British Columbia (Canada)). Mar 1988. 2p. (CONF-880263—9). NTIS (US Sales Only), PC A02; 1; GPO Dep. Order Number DE88013263/JAW.

From Accelerator design workshop; Los Alamos, NM, USA (22 Feb 1988).

This paper discuss the beam instabilities associated with the compressor rings of the PEP storage rings.

44 INSTRUMENTATION

4401 Radiation Instrumentation

REFER ALSO TO CITATION(S) 46660, 46803, 46966, 47256, 47384, 47536, 47603, 47604, 47965, 47994

47258 (DOE/ER/03130—2) An outstanding junior investigator award in experimental high energy physics: Progress report, January 1, 1987--December 31, 1988. Partridge, R. (Brown Univ., Providence, RI (USA). Dept. of Physics). 1 Jul 1988. Contract AC02-76ER03130. 22p. NTIS, PC A03/MF A01; 1; GPO Dep. Order Number DE88014534/JAW.

An experimental program based upon the study of hadron collisions at the highest available energy is being carried out with the support of an Outstanding Junior Investigator Award to Dr. Richard Partridge. The work described in this report includes the development of the Level O trigger for the D{nuil} experiment at Fermilab and the study of detector design and physics of the Superconducting Super Collider (SSC). 6 figs.

47259 (DOE/ER/03130—36C) Superfluid helium as a dark matter detector. Lanou, R.E.; Maris, H.J.; Seidel, G.M. (Brown Univ., Providence, RI (USA). Dept. of Physics). 1988. Contract AC02-76ER03130. 9p. (CONF-8803113—6; COO—3130-TC-36). NTIS, PC A02/MF A01; 1; GPO Dep. Order Number DE88012759/JAW.

From 8. Moriond astrophysics meeting on dark matter; Les Arcs, France (6 Mar 1988).

The properties of liquid helium-four at temperatures in the vicinity of 100 mK suggest that it might be a suitable medium from which to construct a detector for certain types of dark matter. Among these properties are freedom from contaminants producing background and a high multiplicity of carriers (rotons) produced in energy deposition. It is suggested that there are processes available in helium which may permit discrimination between recoil nuclei and electrons of equal energy deposit. 19 refs., 5 figs.

47260 (DOE/ER/40372—1) Research in high energy physics: Scintillating fiber detector development for the SSC: Annual progress report. Ruchti, R.C. (Notre Dame Univ., IN (USA). Dept. of Physics). 14 Jul 1988. Contract AC02-87ER40372. 14p. NTIS, PC A03/MF A01; 1; GPO Dep. Order Number DE88014242/JAW.

The scintillating fiber detector development program at the University of Notre Dame is divided into several components. These include: Research on scintillating glass fiber materials; Research on scintillating plastic fiber materials; Research on scintillating liquids in fiber capillaries; Studies of improvements in image intensification and light amplification of appropriate test and development facilities at Notre Dame. The overall goal of the program is to develop efficient scintillating fiber detectors with long, optical attenuation length, and excellent radiation resistance properties for tracking and microvertex detectors and as component active sampling materials for scintillation calorimetry. We now discuss each of these programs in turn. 2 figs., 3 tabs.

47261 (IAEA-R—3500-F) Study of the yield of the Fricke dosimetry for electron energies from 2 to 90 MeV. Final report for the period 1 June 1984 - 31 October 1987. Berkvens, I.P. (Ghent Rijksuniversiteit (Belgium). Lab. voor Kernfysica). (International Atomic Energy Agency, Vienna (Austria)). Jan 1988. 96p. NTIS (US Sales Only), PC A05/MF A01. Order Number DE88703826/JAW.

The chemical yield for the ferrous sulphate dosimeters was determined for /sup 60/Co-γ radiation and for electron beams of mean energies in the points of measurements, between 2.7 and about 9 MeV. As references, absolute determinations of absorbed dose based on calorimetric measurements, were used. The irradiation geometry for the ferrous sulphate dosimeter differ always due to technical reasons somewhat from that for the absorber of the calorimeter. The investigators took this difference into account. Perturbation correction factors that correct for the difference in electron scattering in the air gaps around the absorber of the calorimeter and in the graphite, were computed with the Monte Carlo method. Also the "reference volume method" recently introduced by the ICRU (report No.35), was applied to correct for the introduction of a ferrous sulphate dosimeter in a graphite phantom. This correction is necessary as the electrons are stopped and scattered in a different way in graphite and water. The results indicated that there is no energy dependence of the chemical yield (G-value) of the dosimeter in the energy range 2.7 to about 9 MeV. A mean G-value of 1,584 (+- 0.006) μ mol/J was obtained. For /sup 60/Co-γ a G-value of 1.601 μ mol/J was determined. However, this difference might not be real but due to the present uncertainty in the stopping-power ratios graphite to water. These ratios are thus made use of to determine the G-value from measurements of the absorbed dose to graphite. Previous investigations, by the group from Gent, indicated a small increase of the G-value with the electron energy. These more accurate determinations thus instead indicate a constant G-value. Refs, figs, tabs.

47262 (INIS-BR—1164, pp 81) Development of CaSO/sub 4/: Dy thin dosemeters for beta radiation detection. Campos, L.L.; Lima, M.F. (Instituto de Pesquisas Energeticas e Nucleares, Sao Paulo (Brazil)). 1987. (In Portuguese). NTIS (US Sales Only), PC A09/MF A01. Order Number DE88703566/JAW. (CONF-8705181—).

From 10. national meeting on condensed matter physics; Caxambu, Brazil (5 May 1987).

47263 (INIS-BR—1164, pp 81) Mutichannel analyzer-microcomputer interface. Ribeiro, M.T.; Paula, A.M. de; Gontijo, I. (Minas Gerais Univ., Belo Horizonte (Brazil). Dept. de Fisica). 1987. (In Portuguese). NTIS (US Sales Only), PC A09/MF A01. Order Number DE88703566/JAW. (CONF-8705181—).

From 10. national meeting on condensed matter physics; Caxambu, Brazil (5 May 1987).

47264 (INIS-BR—1164, pp 106) Photoacoustic spectroscopy with X-rays: detection with open cell. D'Aguiar Neto, M.M.F.; Vargas, H.; Miranda, L.C.M. (Bahia Univ., Salvador (Brazil). Inst. de Fisica; Universidade Estadual de Campinas (Brazil). Inst. de Fisica; Instituto de Pesquisas Espaciais, Sao Jose dos Campos (Brazil)). 1987. (In Portuguese). NTIS (US Sales Only), PC A09/MF A01. Order Number DE88703566/JAW. (CONF-8705181—).

From 10. national meeting on condensed matter physics; Caxambu, Brazil (5 May 1987).

47265 (INIS-BR—1164, pp 28) Characterization and data acquisition system for position sensitive detector. Barbosa, A.F. (Centro Brasileiro de Pesquisas Fisicas, Rio de Janeiro). 1987. (In Portuguese). NTIS (US Sales Only), PC A09/MF A01. Order Number DE88703566/JAW. (CONF-8705181—).

From 10. national meeting on condensed matter physics; Caxambu, Brazil (5 May 1987).

47266 (INIS-BR—1164, pp 72) Energy dependence of different detectors for beta radiation. Albuquerque, M.daP.P.; Xavier, M.; Caldas, L.V.E. (Instituto de Pesquisas Energeticas e Nucleares, Sao Paulo (Brazil)). 1987. (In Portuguese). NTIS (US Sales Only), PC A09/MF A01. Order Number DE88703566/JAW. (CONF-8705181—).

From 10. national meeting on condensed matter physics; Caxambu, Brazil (5 May 1987).

47267 (NIKHEF-H—87-21) Straight line calibration in drift chambers over eight meters. Hartjes, F.; Konijn, J.; Yue Peng. (Nationaal Inst. voor Kernfysica en Hoge-Energiefysica (NIKHEF), Amsterdam (Netherlands). Sectie H). Nov 1987. 14p. NTIS (US Sales Only), PC A03/MF A01. Order Number DE88703935/JAW.

Results are presented from a feasibility study of the use of UV Nitrogen lasers for the alignment of a large system of stacked drift chambers. They prove that a straight line calibration is possible over a distance of eight meters with deviations of less than 10

μm. The results could be reproduced by a computer simulation. 8 refs.; 8 figs.

47268 **(NIKHEF-H—88-1) Test of cathode strip read-out for the multi wire proportional chambers of the inner detector of DELPHI.** Bonapart, M.; Jong, B. de; Timmermans, J.; Udo, F. (Nationaal Inst. voor Kernfysica en Hoge-Energiefysica (NIKHEF), Amsterdam (Netherlands). Sectie H). Jan 1988. 17p. NTIS (US Sales Only), PC A03/MF A01. Order Number DE88703937/JAW.

The outer part of the Inner Detector of the DELPHI experiment consists of five concentric multiwire proportional chambers (MWPC's). The cylindrical cathodes of these MWPC's are each divided into 192 strips which form loops around the beam. The analysis of the charge distribution induced on the 150 cm long strips will provide the coordinates along the beam of the traversing particle. The comparison between anode charge and total induced cathode charge will resolve ghosts in a multitrack event. The five MWPC's as a whole will function as a track trigger. This report presents results from a flat prototype, equipped with full size cathode strips, tested with cosmic rays. The spatial resolution was measured to be 130 μm (2.9% of the strip width). The RMS of the ratio distribution of total cathode charge and anode charge was measured to be 2.2%. We present an analysis of two track charge distributions. This procedure allows to obtain single track performance if the hits are separated by at least 7 mm. 8 refs.; 9 figs.

47269 **(PNL—6583) DOE Radiological Calibrations Intercomparison Program: Results of fiscal year 1987.** Cummings, F.M.; McDonald, J.C. (Pacific Northwest Lab., Richland, WA (USA)). Jun 1988. Contract AC06-76RL01830. 38p. NTIS, PC A03/MF A01; 1; GPO Dep. Order Number DE88014093/JAW.

This report presents the FY 1987 results of the radiological calibrations intercomparison program. The intercomparison operation is discussed, and the equipment is described, particularly the instrument set, the beta source set, and relevant calculations. Solutions to problems and improvements in the program are suggested, and conclusions are then introduced. 9 refs., 3 figs., 8 tabs.

47270 **(SLAC-PEP-NOTE—149) The detection of low-energy charged particles with particle identification up to 3.5 GeV/c.** Perez-y-Jorba, J. (Stanford Linear Accelerator Center, Menlo Park, CA (USA)). [1988]. Contract AC03-76SF00515. 10p. (PEP—149). NTIS, PC A02/MF A01; 1; GPO Dep. Order Number DE88014816/JAW.

A reasonably compact apparatus employing solenoid fields, Cerenkov counters, drift chambers, and time-of-flight capabilities is described. Good particle identification can be obtained through a combination of time-of-flight information and Cerenkov thresholds for π, k, p up to about 3.5 GeV.

47271 **(SLAC-PEP-NOTE—156) Liquid argon gamma ray detector: Variations of the Willis chamber.** Odian, A. (Stanford Linear Accelerator Center, Menlo Park, CA (USA)). [1988]. Contract AC03-76SF00515. 4p. NTIS, PC A02/MF A01; 1; GPO Dep. Order Number DE88015162/JAW.

Application of the liquid argon ionization chamber to gamma ray shower detection is discussed. Several variations are examined, and their merits and deficiencies pointed out. A design which looks promising uses sheets of foil and aluminized strips on mylar as the ion collectors, and detects the current as the output signal.

47272 **(WHC-SA—0173) On-line measurement of stack-gas particulate radionuclides.** Stong, F.S.; Troyer, G.L.; Criddle, J.D. Jr. (Westinghouse Hanford Co., Richland, WA (USA)). Nov 1987. Contract AC06-87RL10930. 13p. (CONF-8711195—1). NTIS, PC A03/MF A01; 1; GPO Dep. Order Number DE88013676/JAW.

From American Nuclear Society winter meeting; Los Angeles, CA, USA (15 Nov 1987).

This paper describes an advanced process-monitoring system for the automatic sample collection, analysis, reporting, and alarming of the concentration of long-lived radionuclides in nuclear process stack-gas effluents. This system, the Moving Filter Radioactive Aerosol Monitor, collects particulates in a conditioned sampling chamber, under computer control, for subsequent and separate alpha and beta counting and analysis. The alpha measurement is performed with a solid-state surface-barrier detector. Beta analysis is performed with a phoswich scintillation detector. A unique alpha-energy analysis program that provides automatic energy calibration and lowered detection limits for plutonium in the presence of high quantities of interfering ^{212}Bi/Po is described. The ^{212}Bi/Po alpha results are further used to monitor system quality and to compensate for the radon daughter beta components in the beta system. Results of the system calibration and detection limits are also presented. 8 refs., 6 figs.

4402 Radiation Effects On Instrument Components, Instruments, Or Electronic Systems

47273 **(LA-UR—88-2073) Alpha, silicon, and iron ion induced current transients in low capacitance silicon and GaAs diodes.** Wagner, R.S.; Bordes, N.; Bradley, J.M.; Maggiore, C.J.; Knudson, A.; Campbell, A. (Los Alamos National Lab., NM (USA)). 1988. Contract W-7405-ENG-36. 28p. (CONF-880730—7). NTIS, PC A03/MF A01; 1; GPO Dep. Order Number DE88014419/JAW.

From 25. annual conference on nuclear and space radiation effects; Portland, OR, USA (12 Jul 1988).

High-speed (<40 ps) current transient and charge collection measurements were make using a wide-band 70-GHz, 6-ps risetime sampling oscilloscope, on GaAs and silicon diodes irradiated by 18 MeV Si, 12 MeV B, 12 and 100 MeV Fe ions, and 3 and 5 MeV alpha particles. Results show that the response of a device to a particle strike can be very fast but strongly depends on the LET (Linear Energy Transfer) of the particle. The rise time dependence with different parameters such as the doping density, bias, at different energies with different particles, is also persented. The data are then compared to the predictions of existing models. 7 refs., 12 figs., 2 tabs.

47274 **(N—88-23582) X-ray production in low energy proton stopping.** Wilson, J.W.; Khandelwal, G.S.; Fogarty, N.T. (National Aeronautics and Space Administration, Hampton, VA (USA). Langley Research Center). Apr 1988. 12p. (NASA-TM—100619; NAS—1.15:100619). NTIS, PC A03/MF A01.

The X-ray yields of stopping protons in an iron-nickel-cobalt alloy are calculated for use in predicting radiation damage in encased electronic devices.

4403 Miscellaneous Instruments

REFER ALSO TO CITATION(S) 46235, 46278, 46553, 47147, 47185, 47875

47275 **(FNAL-TM—1526) An eye for accuracy: Coordinate measuring in an R & D environment.** Kobliska, G.R. (Fermi National Accelerator Lab., Batavia, IL (USA)). Jun 1988. Contract AC02-76CH03000. 11p. (CONF-8806185—2). NTIS, PC A03. Order Number TI88014196/JAW.

From Precision metrology with coordinate measurement systems conference; Gaithersburg, MD, USA (15 Jun 1988).

The Fermi National Accelerator Laboratory (Fermilab) is a high energy physics research facility. Its purpose is to explore the basic composition of matter. Fermilab does not produce a product nor does it produce electrical power. Funded by the Department of Energy, the main tool for its study is the Tevatron, the world's first superconducting particle accelerator. Fermilab fabricates and assembles the majority of magnets and other components for the accelerator rings of the atom smasher. The magnet is the key to accelerating subatomic particle (i.e., protons, anti-protons, etc.) which the particle accelerator uses to collide into other beams or fixed targets. The production of a magnet assembly requires stacking steel laminations precisely the proper size and shape necessary to create the required magnetic field. In this paper, it will be discussed how coordinate measuring is accomplished at Fermilab, and how such

things as tight budgets, and lack of product line can lead to some interesting and useful techniques. 6 figs.

47276 (INIS-BR—1164, pp 99) **Construction and application of a hot x-ray diffraction chamber, for the study of Nb-Ti and N/sub 2/ reaction.** Teixeira, S.R.; Rodrigues, J.A.; Mascarenhas, Y.P. (UNESP, Presidente Prudente (Brazil); Sao Carlos Univ. (Brazil); Sao Paulo Univ., Sao Carlos, SP (Brazil). Inst. de Fisica e Quimica). 1987. (In Portuguese). NTIS (US Sales Only), PC A09/MF A01. Order Number DE88703566/JAW. (CONF-8705181—).

From 10. national meeting on condensed matter physics; Caxambu, Brazil (5 May 1987).

47277 (JINR-R—13-87-576) **Mesooptical microscopes for observation of the vertical particle tracks in nuclear emulsion.** Soroko, L.M. (Joint Inst. for Nuclear Research, Dubna (USSR). Lab. of Nuclear Problems). 1987. 18p. (In Russian). NTIS (US Sales Only), PC A03/MF A01. Order Number DE88703931/JAW.

The design and the operation principle of the mesooptical microscopes intended for observation of the vertical particle tracks in nuclear emulsion are described. Efficiencies of a traditional optical microscope, a traditional confocal microscope, a mesooptical confocal microscope as well as of a mesooptical condensor in finding and estimating coordinates of vertical particle tracks in nuclear emulsion are compared. The mesooptical systems are shown to be several orders of magnitude faster than the traditional optical systems. 17 refs.; 15 figs.

47278 **Reduction of signal reflections for fast-pulse recording with microchannel plate detectors.** Huang, L.Q.; Conzemius, R.J.; Holland, G.E.; Houk, R.S. (Iowa State Univ., Ames (USA)). *Analytical Chemistry;* 60: No. 15, 1635-1637(1 Aug 1988). Contract W-7405-ENG-82.

The performance of a recently developed, movable, home-made microchannel plate detector (MCPD) assembly is comparable to that of a commercial design mounted onto a special flange. A 50-Omega cable with good vacuum characteristics coupled to a 50-Omega vacuum feedthrough allows flexibility in research studies while preserving signal pulse integrity in the special ion optical configurations where the MCPD cannot be positioned close to a vacuum port. This flexibility becomes important as more studies in TOF-MS are performed. For example, placing the detector at various locations along the ion path is especially useful when an ion reflector (13) is being installed and tested. Some experimental apparatus may require impedances other than 50 Omega, but similar techniques can be applied.

47279 **Ballistic deficits in pulse shaping amplifiers.** Loo, B.W.; Goulding, F.S.; Gao, D. (Lawrence Berkeley Lab., Univ. of California, Berkeley, CA (US)). *IEEE (Institute of Electrical and Electronics Engineers) Transactions on Nuclear Science;* 35: No. 1, 114-118(Feb 1988). (CONF-871006—).

From 34. nuclear science symposium and 19. nuclear power systems symposium; San Francisco, CA, USA (21 Oct 1987).

The authors consider the common problem of ballistic deficit which is the loss of output signal amplitude due to the interplay between the finite charge collection times in a detector and the characteristic time constants of the amplifier. Quantitative estimates of ballistic deficits have been developed by using numerical integration techniques on a microcomputer and by exact calculations using Laplace transforms. A new practical procedure is developed in which an actual amplifier with even an unspecified complex-pole network can be accurately related to an "equivalent" semi-Gaussian shaping network whose exact solution is known. Simple formulas for estimating ballistic deficits and resulting degradation in spectral energy resolutions are given.

47280 **Applications of radioluminescent lighting.** Jensen, G.A.; Mathur, S.P. (Pacific Northwest Lab., Richland, WA (USA)). *Transactions of the American Nuclear Society;* 55: 243-244(1987). (CONF-8711195—).

From American Nuclear Society winter meeting; Los Angeles, CA, USA (15 Nov 1987).

Glass-tube radioluminescent (RL) systems have been demonstrated as attractive alternatives to electrically powered airfield marking and lighting systems for remote airfields, rapid runway repair, and other airfield lighting and marking uses. Individual light units for RL systems are self-powered, reliable, easily maintained and deployed, and can be made to produce infrared or visible light. Tests and demonstrations of prototype light units conducted by the US Dept. of Energy's RL Lights Program in recent years for the Air Force, Navy, Army, and Marine Corps and for Florida and Alaska have proved the basic technological worth of RL airfield lighting systems for civilian and military use. The technology has advanced to a point where other military and civilian applications can now be considered. Military applications include emergency degree, damage control, cargo marking, low-level lighting for work areas and other unique uses. Civilian applications include marine navigational aids, roadway marking, emergency escape lighting, lighting for telephone conduit tunnels, and other applications where access to electrical power is limited or difficult to supply or maintain. Isotope options for these applications are shown. Research is expected to produced advanced RL light systems within the next several years.

47281 **Exploiting the optical isotope shift for ultrasensitive isotope analysis with lasers.** Lucatorto, T.B.; Hutchinson, J.M.R.; Whitaker, T.J. *Transactions of the American Nuclear Society;* 52: 360-361(1986). (CONF-860610—Summs.).

From American Nuclear Society annual meeting; Reno, NV, USA (15 Jun 1986).

The authors are currently engaged in a program to determine the potential of resonance ionization mass spectrometry (RIMS) for ultrasensitive isotopic measurements and for the determination of certain nuclear properties (e.g., spin and magnetic moment) of rare isotopes. The RIMS process has been under development for the past 5 yr or so as a technique for ultrasensitive elemental analysis. In RIMS, conventional mass spectrometry is combined with resonant laser ionization to provide sensitive, selective detection of elemental species. The resonance ionization process can achieve (by virtue of enormous resonance enhancement) nearly unit efficiency ionization of a selected elemental species. The mass spectrometer provides mass-specific (more precisely, mass-to-charge ratio specific) detection of the ion with near unit efficiency. Recently, RIMS was used to detect 1000 ^{81}Kr atoms in a background of 10^7 ^{80}Kr and ^{83}Kr atoms and 10^{12} atoms of other elements. It has also provided part-per-billion sensitivity in the measurement of gallium in solid silicon.

4404 Well Logging Instrumentation

REFER ALSO TO CITATION(S) 46388, 46389, 46391

45 EXPLOSIONS AND EXPLOSIVES

4501 Chemical

REFER ALSO TO CITATION(S) 46754, 47133, 47134

47282 (MLM—3496(OP)) **Electrochemical reduction of PETN in two Au/Cu/DAP components at elevated temperature.** Carlson, R.S. (Monsanto Research Corp., Miamisburg, OH (USA). Mound). 1988. Contract AC04-76DP00053. 6p. (CONF-880473—7). NTIS, PC A02/MF A01; 1; GPO Dep. Order Number DE88012865/JAW.

From American Defense Preparedness Association Compatibility symposium; New Orleans, LA, USA (18 Apr 1988).

Aging of PETN/gold bridgewire/phosphor bronze pin/DAP detonator and of another PETN/gold bridgewire detonator at 60 to 100{degree}C has resulted in colored (green or brown) crystals. Infrared spectra were obtained. The possible chemical and electrochemical reactions are discussed. 5 refs., 14 figs. (DLC)

47283 **(MLM—3499(OP)) Recrystallization of HNS [Hexanitrostilbene] for the preparation of detonator grade explosive material.** Feairheller, W.R.; Donaldson, T.A.; Thorpe, R. (Monsanto Research Corp., Miamisburg, OH (USA). Mound). 1988. Contract AC04-76DP00053. 6p. (CONF-880473—10). NTIS, PC A02/MF A01; 1; GPO Dep. Order Number DE88012862/JAW.

From American Defense Preparedness Association Compatibility symposium; New Orleans, LA, USA (18 Apr 1988).

A process parameter study was conducted using Hexanitrostilbene (HNS) to determine the conditions needed to prepare a wide range of surface areas and other properties using the solvent-nonsolvent type of recrystallization. HNS was recrystallized over a range of surface areas between 0.5 and 20 m^2/g (BET method). Changes in the processing conditions (such as the order and rate of addition, temperatures of solvent and nonsolvent, choice of washing liquid, and drying conditions) caused dramatic changes in the surface area, particle size and distribution, physical appearance, tap density, flowability, and residual solvent content. 6 refs., 4 figs.

47284 **(MLM—3503(OP)) Development of processes for reliable detonator grade very fine secondary explosive powders.** Thorpe, R.; Feairheller, W.R. (Monsanto Research Corp., Miamisburg, OH (USA). Mound). 1988. Contract AC04-76DP00053. 6p. (CONF-880473—9). NTIS, PC A02/MF A01; 1; GPO Dep. Order Number DE88012863/JAW.

From American Defense Preparedness Association Compatibility symposium; New Orleans, LA, USA (18 Apr 1988).

A number of manufacturing procedures for the preparation of very fine detonator grade explosive powders have been developed at Mound. Strict safety and housekeeping procedures are adhered to to assure a safe operation and a clean product. Over the years much of the effort has been concerned with PETN and HMX and the methods needed to prepare these materials with surface areas ranging from 900 to 20,000 cm^2/g (Fisher Sub Sieve Sizer method). The current trend is toward making available alternate insensitive high explosive (IHE) materials for slapper detonators. An increase in their sensitivity is needed and can be achieved by increasing powder surface area while maintaining high purity. Mound has developed a continuous crystallization process for the IHE TATB which results in surface areas ranging from 25 to 30 m^2/g (BET method). 3 refs., 4 figs.

47285 **(UCRL—53860) The initiation and detonation of explosives: An alternative concept.** Walker, F.E. (Lawrence Livermore National Lab., CA (USA)). 11 Jan 1988. Contract W-7405-ENG-48. 29p. NTIS, PC A03/MF A01; 1; GPO Dep. Order Number DE88014199/JAW.

An observed phenomenon designated as low-velocity detonation is not described properly by the ZND theory of detonation, nor is the deflagration-to-detonation transition, in which a rapidly burning explosive suddenly detonates with no external initiating shock. The alternative concept discussed can provide useful explanations of these phenomena. It also is a microscopic or atomic-scale model that is consistent with modern molecular dynamics and quantum-mechanical descriptions of shock waves in explosive materials. 80 refs., 19 figs.

47286 **(UCRL—97861) Role of deflagration in explosive response.** Lee, E.L.; Weston, A.M. (Lawrence Livermore National Lab., CA (USA)). 20 Jun 1988. Contract W-7405-ENG-48. 28p. (CONF-880693—4). NTIS, PC A03/MF A01; 1; GPO Dep. Order Number DE88014139/JAW.

From 19. international ICT conference on combustion and detonation; Karlsruhe, F.R. Germany (29 Jun 1988).

Measurements on materials of varying burn rates, particularly at high pressure, show a strong correlation with the violence of the response of thes materials to a range of hazard stimuli. We have analyzed the response using somewhat idealized model for deflagrating materials. The results can be compared with various tests for hazard reponse. We have studied confinement effects and chosen a particular confinement to quantify the explosive response. The effects of porosity, ignition behavior, and laminar burn rate are clearly revealed by the results of the model. Possibilities for formulating less vulnerable materials are discussed. 9 refs., 9 figs.

4502 Nuclear

REFER ALSO TO CITATION(S) 46665

4503 Explosion Detection

47287 **(UCRL—21065) Seismological studies: Final report.** Brune, J.N. (Lawrence Livermore National Lab., CA (USA); Nevada Univ., Reno (USA). Seismological Lab.). Jun 1988. Contract W-7405-ENG-48. 27p. NTIS, PC A03/MF A01; 1; GPO Dep. Order Number DE88013803/JAW.

A good quality, high-frequency digital data set of earthquakes recorded at short hypocentral distances has been assembled in common formats. This data set was used to evaluate the source spectral P-wave falloff of the earthquakes and explosions compared to theoretical predictions. It was found that the earthquake data disagreed with the Archambeau relaxation source theory (which has a falloff proportional to ω/sup {minus}3/ beyond the corner frequency) for large moment events and was approximately in agreement with the Brune model with a falloff of ω/sup {minus}2/. The explosions were found to have less high frequency energy at 30 Hz than predicted by the Sharpe model. 50 refs., 4 figs., 1 tab.

50 ENVIRONMENTAL SCIENCES, ATMOSPHERIC

5001 Basic Studies

REFER ALSO TO CITATION(S) 47088

47288 **(GKSS—88/E/5) Verification of the pollutant transport model 'MODIS' using EPRI plains site data from a tall stack.** Petersen, G.; Eppel, D.; Grassl, H. (GKSS-Forschungszentrum Geesthacht G.m.b.H., Geesthacht-Tesperhude (Germany, F.R.); GKSS-Forschungszentrum Geesthacht G.m.b.H., Geesthacht-Tesperhude (Germany, F.R.). Inst. fuer Physik). 1988. 14p. Special print from Boundary-Layer Meteorol. (Oct-Dec 1987) vol. 41(1-4) p. 265-277.

A comprehensive numerical model for the simulation of pollutant dispersion from a point source into the mixing layer of the atmosphere over flat terrain is described. A moment reduction technique is used (MODIS = Moment Distribution) to combine the simplicity of the Gaussian plume description with the versatility of Eulerian grid formulations. Turbulent dispersion coefficients are parameterized in terms of mean square wind variances which in turn are obtained by a simplified second order closure model. The data base of the 'EPRI Plume Model Validation and Development Project' is used to validate the model for wind velocities above 0.5 m/s and for horizontal scales up to about one hundred kilometers. The model describes the three-dimensional structure of a plume also for stable conditions including a nighttime low level jet. For a convective planetary boundary layer it underestimates maximum ground concentration as do other models. However, it is capable of approaching measured maximum ground concentration under stable conditions.

5002 Chemicals Monitoring And Transport

REFER ALSO TO CITATION(S) 46256, 46720, 47136, 47397

47289 **(CONF-8804148—2) Modeling forest responses to air pollution: Discussion summary.** Hanson, P.J. (Oak Ridge National Lab., TN (USA)). 1988. Contract AC05-84OR21400. 7p. NTIS, PC A02/MF A01; 1; GPO Dep. Order Number DE88014551/JAW.

From Conference on forest growth: process modeling of response to environmental stress; Gulf Shores, AL, USA (19 Apr 1988).

The discussion session outlined three required elements of any approach to modeling forest responses to air pollution: deposi-

tion models, models of primary plant responses to air pollutants, and models to translate those responses into altered patterns of growth. The open discussion included a range of topics covering aspects of each of these three areas. The following summary was derived from notes taken during the discussions and a tape recording of the actual session. Every attempt has been made to attribute questions and comments to the appropriate individuals.

47290 **(DOE/ER/60468—2) Design and analysis of large-scale atmospheric dispersion experiments: Second annual progress report, [July 1, 1987-October 31, 1988].** Baer, F.; Holland, J. (Maryland Univ., College Park (USA). Dept. of Meteorology). Jun 1988. Contract FG05-86ER60468. 7p. NTIS, PC A02/MF A01; 1; GPO Dep. Order Number DE88012911/JAW.

The goals of this research are to aid in the design of future large-scale ground-level atmospheric tracer/sampling experiments of the CAPTEX (Cross-Appalachian Tracer Experiment)/ ANATEX (Across North America Tracer Experiment) type, to develop probabilistic models of tracer plume concentration/dosage distributions and to use these models to assess the effects of sampling grid design parameters on errors of estimation of experimental tracer plume distribution parameters. 6 refs.

47291 **(DOE/ER/60511—1) Aerosol deposition in human upper airways: Final technical report.** Swift, D.L. (Danish National Inst. of Occupational Health, Hellerup). [1988]. Contract FG02-87ER60511. 9p. NTIS, PC A02/MF A01; 1; GPO Dep. Order Number DE88014112/JAW.

This is a final report of a one year research effort which was intended to obtain experimental data and develop methods for aerosol deposition in the human upper airways. The study was carried out while the principal investigator was visiting research scientist at the Danish National Institute of Occupational Health. Some of the tasks were carried out collaboratively at other institutes to be described below. The specific aims of the research program were to obtain particle deposition data for ultrafine particles in a nasal replicate model, and to develop methods by which replicate models of the upper human airways could be constructed for other ages and conditions. Of particular interest to this third aim is the possibility of constructing replicate models for the upper related deposition efficiency could be determined. 3 figs.

47292 **(ENEA-RT/STUDI—87-4) Air pollutant emission by combustion processes in Italy.** Bocola, W.; Cirillo, M.C. (ENEA, Rome (Italy)). Dec 1987. 18p. NTIS (US Sales Only), PC A03/MF A01. Order Number DE88754223/ JAW.

An estimate is made of the emissions, due to combustion processes, of the five main air pollutants: sulphur oxides, nitrogen oxides, total suspended particles, carbon monoxide and volatile organic compounds. A first estimate, intended to provide some indication of the emission time trend, covers the years 1976, 1980 and 1984. Here, emissions are divided according to large fuel-consuming sectors (industry, agriculture, thermal power plants, residential and commercial transportation), and the type of fuel used (coal, lignite, natural gas, oil products). A further estimate is made, with reference to 1980, of identified emissions in relation to individual Italian Regions and large activity sectors.

47293 **(EPA/600/4—87/035) Acid precipitation in North America: 1985 annual and seasonal data summaries from Acid Deposition System data base.** Sweeney, J.K.; Olsen, A.R. (Environmental Protection Agency, Research Triangle Park, NC (USA). Environmental Monitoring Systems Lab.; Pacific Northwest Lab., Richland, WA (USA)). Nov 1987. Contract AC06-76RL01830. 451p. NTIS, PC A20/MF A01; 1; GPO Dep. Order Number DE88013563/JAW.

This report summarizes the 1985 wet deposition precipitation chemistry data collected in North America and available in the Acid Deposition System (ADS) data base. Interpretative statistical analyses are not a focus of this report; however, users of the report will learn about major wet deposition monitoring networks in North America, the extent of their geographic coverage, and general characteristics of wet deposition for 1985. An overview of each network is given. Annual and seasonal statistical summaries for 1985 are provided for pH, hydrogen ion (derived from pH), and the ion species sulfate, nitrate, ammonia, calcium, chloride, sodium, magnesium and potassium. 24 refs., 7 figs., 7 tabs.

47294 **(GAO/RCED—88-32) Air pollution: Information on EPA's efforts to control emissions of sulfur dioxide.** (General Accounting Office, Washington, DC (USA). Resources, Community and Economic Development Div.). 1987. 28p. General Accounting Office, PO Box 6015, Gaithersburg, MD 20877.

Sulfur dioxide not only by itself is a health risk but it contributes to the formation of acid rain prompting the Environmental Protection Agency to develop two models - The Regional Acid Deposition Model and the Complex Terrain Dispersion Model - to improve its ability to set standards at levels intended to protect the public's health and welfare. RADM, which addresses the acidic deposition, has exceeded EPA's original $11.5 million cost estimate by $3.5 million and EPA estimates the final cost to be about $30 million when completed in September 1990. EPA originally estimated CTDM, which addresses airborne pollutants, to cost $5.7 million but so far it has expended $8.5 million through FY 1987. Additional improvements and refinements to the models will be necessary before EPA can use them to make regulatory decisions to reduce pollution.

47295 **(GKSS—88/E/4) Optimization of range and sensitivity in differential absorption and scattering lidar.** Weitkamp, C.; Lahmann, W.; Staehr, W. (GKSS-Forschungszentrum Geesthacht G.m.b.H., Geesthacht-Tesperhude (Germany, F.R.); GKSS-Forschungszentrum Geesthacht G.m.b.H., Geesthacht-Tesperhude (Germany, F.R.). Inst. fuer Physik). 1988. 9p. (In German). Special print from Laser Optoelektron. (1987) Vol. 19(4) p. 375-381.

The optimization of range and sensitivity in differential adsorption and scattering lidar requires a number of features not obvious from elementary lidar theory. Several of these features are discussed, and their effective use is demonstrated with a four-laser SO/sub 2//NO/sub 2/ DAS lidar.

47296 **(LBL—25348) Real-time measurement of the size fractionation of aerosol black carbon during the South Coast Air Quality Study, June 13-September 4, 1987, Claremont College, Claremont, California: Preliminary report.** Hansen, A.D.A.; Novakov, T. (Lawrence Berkeley Lab., CA (USA)). May 1988. Contract AC03-76SF00098. 49p. NTIS, PC A03. Order Number DE88014045/JAW.

During the periods June 13 to July 28 and August 17 to September 4, 1987, the Atmospheric Aerosol Group of Lawrence Berkeley Laboratory participated in the South Coast Air Quality Study conducted at Claremont College, Claremont, California. We used a multi-channel aethalomether preceded by size-selective inlets to determine the concentration of aerosol black carbon in two size ranges in real time. In this report we present our results from this study in the form of one-hour and periodic (typically 12-hour) averages of carbon concentrations for the total suspended aerosol and for the fraction having aerodynamic diameter smaller than approximately 0.3 μm. The total concentration results show daily mean values generally ranging from 1 to 4 $\mu g/m^3$, with a diurnal cycle showing little variation during nighttime hours and a pronounced peak between the hours of 8 am and 10 am. The results for the size fractionation show that the great majority of the aerosol black carbon was found in the size range smaller than 0.3 μm: however, this fraction showed a systematic diurnal variation with a decline in the morning and the mid-day periods. 13 refs., 26 figs., 9 tabs.

47297 **(PB—88-205497/XAB) Analyses of Great Smoky Mountain red spruce tree-ring data. Forest Service general technical report.** Van Deusen, P.C. (Forest Service, New Orleans, LA (USA). Southern Forest Experiment Station). May 1988. 74p. (FSGTR-SO—69). NTIS, PC A04/MF A01.

Contents include: Southern Appalachian Red Spruce--Fraser Fir Forests; A tree ring analysis of Red Spruce in the Southern Appalachian Mountains; Utilizing time series models and spatial analysis of forecast residuals for tree-ring analysis of Red Spruce; A frac-

tal approach to analysis of tree-ring increments; Red Spruce Tree Ring Analysis using a Kalman Filter.

47298 (PNL-SA—15217, pp 95-110) **Cost-effective monitoring of mixtures of volatile organic compounds in residences.** Gammage, R.B. (Oak Ridge National Lab., TN (USA)). 1987. NTIS, PC A99/MF A01. Order Number DE88007332/JAW. (CONF-851027—). Contract AC05-84OR21400.

From 24. Hanford life sciences symposium and environmental research on complex organic mixtures; Richland, WA, USA (20 Oct 1985).

Volatile organic compounds (VOC) in indoor air are an important and inescapable component of everyone's exposure to complex organic mixtures. A tiered approach is outlined for cost-effective monitoring of VOC. A hand-held, direct-reading photoionization detector (PID) is suitable for rapid initial screening, or following temporal changes if concentrations are high. Readings can be expressed as equivalent units of toluene or some other VOC. Moderately sophisticated measurements can be made in near real time with a portable gas chromatograph with PID. The more abundant hydrocarbons, such as benzene, toluene, and straight and branched chain alkanes, are usually measurable in indoor air. Passive monitoring devices based on Tenax-GC sorbent show promise for the future. The method of choice for collection and definitive analysis of VOC is trapping on sorbents of Tenax-GC and carbonaceous resins with subsequent thermal desorption and analysis by selected-ion mass spectroscopy. Measurements in homes in East Tennessee show that overall VOC levels usually ranged from a few tenths to a few mg/m³. Gasoline fumes are a major VOC component, especially in homes with attached garages. Chlorinated alkanes and alkenes are a smaller fraction of total VOC and are usually present at a tenth of a mg/m³ or less. For all types of measurement, indoor VOC concentrations exceeded those measured outdoors.

47299 (PNL-SA—15217, pp 695-702) **Reproductive hazards in areas with complex mixtures of air pollutants.** Nordstroem, S.; Forsberg, B. (Univ. of Umea (Sweden)). 1987. NTIS, PC A99/MF A01. Order Number DE88007332/JAW. (CONF-851027—).

From 24. Hanford life sciences symposium and environmental research on complex organic mixtures; Richland, WA, USA (20 Oct 1985).

A polluted, urbanized and industrialized municipality in southern Sweden, Landskrona, was divided by the local Environmental Health Office into four areas with estimated exposure gradients of: (A) most polluted, (B) less polluted, and (C) least polluted. A surrounding area (D) was selected as a reference. Pregnancy outcome was analyzed by checking case records for women born in 1930 or later. No significant differences in the frequency of spontaneous abortions or stillbirths were found. Birth weights among the 9614 children varied significantly among the four study areas, showing an effect gradient roughly following the exposure gradient. The effect on birth weights was most noticeable in later pregnancies (>2), confirming results of earlier Swedish studies. There was a higher frequency of congenital malformations in the most polluted area compared to other areas. Of five children with anencephaly, four were among the 1622 children born in area A; one child with anencephaly was found among 3966 children in area B; and none were found among 4152 children in areas C and D. Results suggest a connection between increased air-pollution levels and decreased birth weights. A connection between congenital malformations in area A and air pollutions cannot be excluded. As in many industrialized and urbanized areas around the world, there is a complex mixture of organic and inorganic pollutants in the Landskrona region and a need for comprehensive epidemiological studies on reproductive hazards in polluted areas.

47300 (UCID—19897) **The 1981-1982 NCLAN [National Crop Loss Assessment Network] program at LLNL: The effects of ozone and sulfur dioxide, singly and in combination, on field-grown tomato.** Surano, K.A.; Mutters, R.G.; Temple, P.J.; Bingham, G.E.; Kercher, J.R.; Shinn, J.H. (Lawrence Livermore National Lab., CA (USA)). Jul 1987. Contract W-7405-ENG-48. 63p. NTIS, PC A04/MF A01; 1; GPO Dep. Order Number DE88014185/JAW.

The combined effects of ozone (O{sub 3}) and sulfur dioxide (SO{sub 2}) exposures on tomato (Lycopersicon esculentum Mill.) crop yields were measured during the 1981 and 1982 growing seasons. The effort, part of the National Crop Loss Assessment Network (NCLAN), had the objective of determining the yield dose response of tomato grown under commercial conditions. Dose response was determined using step-wise multiple regression techniques and was expressed as reduction in marketable yield as a function of increased pollutant levels. The crops were harvested during mid-September 1981 and during mid-October 1982. No O{sub 3}- or So{sub 2}-induced visible injury symptoms (lesions, chlorosis, or becrosis) were apparent on foliage or fruits. Total marketable fruit fresh weight was used as the dependent variable in the regression analysis because it most closely represented the economic value of the crop. Comparison of chambered- and companion-plot data showed that the chambers themselves caused significant effects on the crop. Yields were reduced 12% in 1981 and 24% in 1982 due to the chambers. There was also more unripened fruit within the chambers because of chamber-induced uneven distribution of an aerially-applied ripening agent. Dose-response results were independent of the chamber effects. Based on companion-plot data, the yield of the crop in the research area was 65{plus-minus}2 Mg ha{sup {minus}1} in both years. The research-area yields correlated well with those from the adjacent commercial plantation. With respect to tomato production in the San Joaquin Valley, we recommend that an air quality management strategy be adopted to contain ambient O{sub 3} concentrations at or below present levels. Containment at present levels would avoid O{sub 3}-induced tomato yield reductions greater than 7%, even during atypical years such as 1982. 26 refs., 17 figs., 9 tabs.

47301 (UCID—21334) **CHAWS [Chemical HAzard Warning System] user's guide: System description and standard operating procedures, Tooele Army Depot, south.** Shinn, J.H.; Novo, M.G. (eds.). (Lawrence Livermore National Lab., CA (USA)). Mar 1988. Contract W-7405-ENG-48. 154p. NTIS, PC A08/MF A01; 1; GPO Dep. Order Number DE88014186/JAW.

The Chemical HAzard Warning System (CHAWS) has been designed to collect meteorological data and to display, in real time, hazardous chemical dispersion as a result of an accidental release. Meteorological sensors are placed strategically around each installation and are used to calculate direction and hazard distance for the release. These data are then graphically displayed on a computer screen showing a site map and arrows depicting the release direction and distance traveled. The objectives of CHAWS are as follows: to determine the trajectory of the center of mass of released material from the measured wind field; to calculate the dispersion based on the measured lateral turbulence intensity (sigma theta); to determine the height of the mixing zone by measurement of the inversion height and wind profiles up to an altitude of about 1 km; to archive meteorological data for potential use in climatological descriptions for emergency planning; to archive air-quality data for preparation of compliance reports; and to provide access to the data for realtime hazard analysis purposes.

47302 (UCRL—21059) **Characterization of combustion aerosols for haze and cloud formation: Final report.** Hallett, J.; Hudson, J.G.; Rogers, C.F. (Lawrence Livermore National Lab., CA (USA)). Mar 1988. Contract W-7405-ENG-48. 32p. NTIS, PC A03/MF A01; 1; GPO Dep. Order Number DE88013806/JAW.

Aerosols resulting from the combustion of acetylene, wood, and JP-4 aviation fuels have been characterized in both the laboratory and the larger field scales by activity as cloud condensation nuclei (CCN), the total particle or condensation nuclei (CN) count, ion chromatography (IC) on filter samples, and morphology by scanning electron microscopy. The CCN/CN ratio for a given aerosol sample is a quantitative indicator of the ability of a combustion aerosol to become involved in atmospheric removal by nucleation scavenging. On both the laboratory and the field scales, this ratio was in the range 0.2 to 1.0 for the wood combustion aerosol, 0.2 to 0.5 for the acetylene case, and only 0.01 to 0.03 for JP-4. The CCN/CN ratios are identical for both the field and laboratory studies, implying that laboratory studies of CCN activities can be justifi-

ably extrapolated to field studies. Aging and size-classified nucleation studies are also reported. 20 refs., 9 figs., 3 tabs.

47303 **(UCRL—97377) A review of recent work in atmospheric dispersion of large spills.** Koopman, R.P.; Ermak, D.L.; Chan, S.T. (Lawrence Livermore National Lab., CA (USA)). May 1988. Contract W-7405-ENG-48. 18p. (CONF-8805103—5). NTIS, PC A03/MF A01; 1; GPO Dep. Order Number DE88013105/JAW.

From Hazardous material spills conference; Chicago, IL, USA (16 May 1988).

Large-scale spills of hazardous materials often produce gas clouds which are denser-than-air. The dominant physical processes which occur during dense-gas dispersion are very different than those recognized for trace gas releases in the atmosphere. Most important among these processes are stable stratification and gravity flow. Dense-gas flows displace the ambient atmospheric flow and modify ambient turbulent mixing. Thermodynamic and chemical reactions can also contribute. Some materials flash to aerosol and vapor when released and the aerosol can remain airborne, evaporating as it moves downwind, causing the cloud to remain cold and dense for long distances downwind. Dense-gas dispersion models, which include phase change and terrain effects have been developed and are capable of simulating many possible accidental releases. A number of large-scale field tests with hazardous materials such as liquefied natural gas (LNG), ammonia (NH_3), HF, and N_2O_4 have been performed and used to evaluate models. The tests have shown that those gas concentrations up to ten times higher than those predicted by trace gas models can occur due to aerosols and other dense-gas effects. A methodology for model evaluation has been developed which is based on the important physical characteristics of dense-gas releases. 43 refs., 14 figs.,2 tabs.

47304 **Comparison of three aerosol sampling techniques and the differences in the nitrate determined by each.** Johnson, S.A.; Kumar, R. (Argonne National Lab., Argonne, IL (US)). pp 183-188 of Measurement of toxic and related air pollutants: Proceedings of the 1987 EPA/APCA symposium. Pittsburgh, PA; Air Pollution Control Assoc. (1987). (CONF-8705149—).

From EPA/APCA symposium on measurement of toxic and related air pollutants; Research Triangle Park, NC, USA (3 May 1987).

Ambient aerosol samples were collected simultaneously with three different methods, one a size fractionated impactor sampler and two filter samplers. Infrared spectroscopy was used to analyze the collected aerosol using attenuated total internal reflection for the impactor samples and direct transmission through ultra-thin teflon membrane filters for the filter samples. All samples were analyzed as soon as possible after collection; some were reanalyzed after being stored in closed petri dishes for up to 10 days. A major purpose of the study was to evaluate the neutralization of acidic sulfate aerosols after sample collection by the filtration techniques. No acidic sulfate was found in any of the samples collected during the field study. However, significant differences were observed in the nitrate content of the samples collected by the different samplers. Also, in several samples collected with the ATR impactor the nitrate content decreased upon storage. In some cases the nitrate absorbance bands diminished to zero; in other cases the nitrate initially decreased and then remained stable; in yet another case, a high level of nitrate persisted over several days. The results indicate that two different types of nitrate compounds were present in the samples, one more "volatile" than the other, although the infrared spectra were consistent with both of them being ammonium nitrate.

5003 Radioactive Materials Monitoring And Transport

REFER ALSO TO CITATION(S) 46439, 46440, 47272, 47381

47305 **(INIS-BR—1201) Air monitoring during the decontamination process of same areas in Goiania.** Ney, C.L.V.; Xavier, R.; Estrada, J.J.S.; Lourenco, M. (Instituto de Radioprotecao e Dosimetria, Rio de Janeiro (Brazil)). 1988. 1p. (In Portuguese). NTIS (US Sales Only), PC A02/MF A01. Order Number DE88703893/JAW.

47306 **(RISO-M—2692) Final report on the Risoe monitoring programme after the Chernobyl accident for the period October 1, 1986-September 30, 1987. Main Report.** Aarkrog, A.; Nielsen, S.P.; Dahlgaard, H.; Lauridsen, B.; Soegaard-Hansen, J. (Risoe National Lab., Roskilde (Denmark)). Jan 1988. 82p. (In Danish). NTIS (US Sales Only), PC A05/MF A01. Order Number DE88753657/JAW.

In cooperation with the National Agency of Environmental Protection in Denmark, Risoe National Laboratory has examined the radioactive contamination from the Chernobyl accident. The programme for these investigations was an expansion of the countrywide monitoring programme operated since 1962 by Risoe National Laboratory. The present report cover the period October 1, 1986 to September 30, 1987. All types of environmental samples relevant for radioactive contamination has been analysed. Most samples were collected countrywide and all samples were analysed for radiocaesium (/sup 134/Cs and /sup 137/Cs). Many samples were furthermore anlaysed for /sup 90/Sr and in a few samples transuranic elements (/sup 29,240/Pu, /sup 241/Am and /sup 242/Cm) were determined. On the basis of the diet and wholebody measurements of radiocaesium the individual mean dose equivalent commitment from Danish diet consumed in the first two years after the Chernobyl accident was calculated to 27 μ Sv.

5005 Site Resource And Use Studies

47307 **(ORNL/TM—10689) Sampling and analysis of diesel engine exhaust and the motor pool workplace atmosphere: Final report, [August 1, 1984-February 28, 1988].** Griest, W.H.; Jenkins, R.A.; Tomkins, B.A.; Moneyhun, J.H.; Ilgner, R.H.; Gayle, T.M.; Higgins, C.E.; Guerin, M.R. (Oak Ridge National Lab., TN (USA)). Jun 1988. Contract AC05-84OR21400. 93p. NTIS, PC A05/MF A01; 1; GPO Dep. Order Number DE88013504/JAW.

Diesel engine exhaust and the motor pool workplace atmosphere at four garages in Fort Carson, CO, were sampled and analyzed for organic compounds to better define the fuel related workplace atmosphere contamination to which military personnel are exposed the most frequently and at the highest concentrations. Both time averaged and time resolved samples were collected. Major organic vapor phase compounds were determined using thermal-desorption GC. Major particulate phase organic compounds were analyzed by solvent extraction and GC. PAH were measured using HPLC/GCMS. The organic composition was very complex. Concentrations of individual compounds varied over ca. an order of magnitude from location to location or at the same location over time. Although diesel engine exhaust was a major contributor to workplace atmospheric contamination, it would not be a chemically accurate surrogate for the toxicological study of the latter. 37 refs., 13 figs., 17 tabs.

5006 Regulations

REFER ALSO TO CITATION(S) 46685, 46721, 46723, 47326

51 ENVIRONMENTAL SCIENCES, TERRESTRIAL

5101 Basic Studies

REFER ALSO TO CITATION(S) 47052

47308 **(DOE/ER/60242—4) Vegetation analysis and mapping of the R4D research site, Imnavait Creek, Alaska: Progress report, October 1, 1987-June 30, 1988.** Walker, D.A.; Walker, M.D.; Lederer, N.D. (Colorado Univ., Boulder (USA). Plant Ecology Lab.). 30 Jun 1987. Contract FG02-84ER60242. 163p. NTIS, PC A08/MF A01; 1; GPO Dep. Order Number DE88012953/JAW.

This document contains a summary of research accomplished by the University of Colorado's Institute of Arctic and Alpine Research (INSTAAR) Plant Ecology Laboratory for the

Department of Energy's R4D research program during the period October 1, 1987 to June 30, 1988.

47309 **(DOE-RW—88.028) Reasons for the decline in bird numbers breeding near the Ravenglass Estuary.** Anderson, N.; Evans, P.R. (Department of the Environment, London (UK)). Jul 1987. 52p. NTIS (US Sales Only), PC A04/MF A01. Order Number DE88754529/JAW.

Final report.

Black-headed gulls breeding at Ravenglass (and at other coastal sites in Cumbria) fed exclusively inland during the breeding season and so could not have acquired any radionuclide contaminants present in the estuarine muds and invertebrates. They, and two other ground-nesting bird species have suffered severe disturbance and predation by foxes at Ravenglass in recent years. In contrast, the Shelduck, which nests in holes (and so does not suffer fox predation) but feeds at Ravenglass on estuarine invertebrates, has bred successfully. Levels of heavy metal contaminants in gull tissues and eggs were too low to have caused the observed breeding failures at Ravenglass. Gulls feeding on the estuary before the breeding season, but which then moved to other (inland) breeding sites, nested successfully.

47310 **Problems with the triangular model for representing plant strategies.** Loehle, C. (Savannah River Ecology Lab., Aiken, SC (USA)). *Ecology;* 69: No. 1, 284-286(Feb 1988).

Triangular models have been used in plant ecology to represent environmental factors and plant life history strategies as a substitute for the r-K continuum. The purpose of this note is to point out some mathematical properties of this model that can lead to distortions of data. Data shows that the triangular data representation scheme distorts data, results in loss of information, and generates overly restrictive assumptions about strategic or environmental trade-offs. Their use is therefore not recommended. Standard rectilinear two- or three-dimensional plots are preferable. For more than three dimensions, the rectilinear scheme is still adequate, though graphic presentation may be difficult. The lessons of this analysis extend beyond the model of Grime to include other misleading graphical methods in ecology; for example, similar problems of data distortion have plagued multivariate approaches such as principal component analysis (PCA).

5102 Chemicals Monitoring And Transport

REFER ALSO TO CITATION(S) 46312, 46750, 47301, 47322, 47333, 47338

47311 **(PNL-SA—15217, pp 457-471) Sorption of organic chemicals by soils from multi-solvent and multi-sorbate mixtures.** Rao, P.S.C.; Lee, L.S. (Univ. of Florida, Gainesville (USA)). 1987. NTIS, PC A99/MF A01. Order Number DE88007332/JAW. (CONF-851027—).

From 24. Hanford life sciences symposium and environmental research on complex organic mixtures; Richland, WA, USA (20 Oct 1985).

This paper reviews recent experimental and theoretical developments in describing organic pollutant sorption by soils and other sorbents from complex mixtures. The authors discuss application of a solvophobic theory for predicting sorption of hydrophobic organic chemicals (HOC) from mixed solvents consisting of water and water-miscible organic cosolvents. Sorption of HOC from a binary solvent mixture decreases exponentially with increase in the fraction of organic cosolvent. Model parameter values estimated from binary solvent data can be used to predict HOC sorption from more complex solvent mixtures. This theory is verified experimentally using HOC sorption data for binary, ternary, and quinary solvents. To explain HOC sorption from mixtures of water and immiscible organic solvents, simultaneous partitioning of HOC between water and immiscible solvent, HOC binding with microemulsified organic solvent in water, and HOC sorption by soil from water must be explicitly accounted for. HOC sorption data supporting this approach are presented. Data available to date suggest that nonioninc HOC sorb independently from multi-sorbate mixtures. However, for sorption of ionizable and ionic organic sorbates, competitive sorption depends on sorbent properties, sorbate characteristics, and solvent composition. Data for both types of sorption are reviewed.

47312 **(PNL-SA—15217, pp 473-485) Competitive adsorption of aromatic nitrogen bases on subsurface materials.** Zachara, J.M.; Thomas, B.L. 1987. NTIS, PC A99/MF A01. Order Number DE88007332/JAW. (CONF-851027—).

From 24. Hanford life sciences symposium and environmental research on complex organic mixtures; Richland, WA, USA (20 Oct 1985).

The inorganic sorbate pairs quinoline-acridine and quinoline-pyridine were contacted at micromolar concentrations with low-organic subsoils to determine if competitive sorption occurred. Using quinolines as the reference compound, competition was observed between sorbates in the acidic subsoil when the soil-water pH promoted compound ionization. Pyridine and quinoline mutually competed while acridines sorbed independently. Acridine was the least soluble and most strongly adsorbed compound and induced the greatest reduction in quinoline binding. Competitive sorption was minimal in the higher pH subsoil where the compounds are neutral. It is suggested that competition occurred between the protonated species for a subset of reactive charged sites that exhibited high affinity for the organic cations.

47313 **(WHC-SA—0100) Asbestos management during decommissioning.** Miller, C.E. Jr.; Miller, R.L. (Department of Energy, Richland, WA (USA). Richland Operations Office; Westinghouse Hanford Co., Richland, WA (USA)). Oct 1987. Contract AC06-87RL10930. 6p. (CONF-8710343—1). NTIS, PC A02/MF A01; 1; GPO Dep. Order Number DE88013587/JAW.

From 4. meeting of the Nuclear Energy Agency technical advisory group; West Valley, NY, USA (12 Oct 1987).

This paper discusses general areas of asbestos management related to decommissioning of nuclear facilities in the US including regulations, removal practices, packaging, disposal, and measurement for release.

5103 Radioactive Materials Monitoring And Transport

REFER ALSO TO CITATION(S) 46379, 46416, 46417, 46418, 46419, 46420, 46421, 46439, 46440, 46441, 46455, 47048, 47051, 47309, 47313, 47338, 47375, 47381

47314 **(DPST—86-468) Sediment transport studies in Tims Branch.** Hayes, D.W. (Savannah River Lab., Aiken, SC (USA)). 23 Jun 1986. Contract AC09-76SR00001. 17p. NTIS, PC A03/MF A01; 1; GPO Dep. Order Number DE88014518/JAW.

In 1984, the spillway of Steed Pond fed by Tims Branch collapsed and the pond slowly drained. Consideration was given to leaving the pond dry, but concern was expressed that the uranium accumulated in the sediments from the 300 Area discharges to Tims Branch might be eroded and transported to Upper Three Runs Creek. This study shows that the measured amount of sediment transported to Upper Three Runs Creek from Tims Branch No. 5, about two miles below Steed Pond, was about the same as in past years before the spillway collapsed. What little erosion that has occurred in the exposed sediments will be even less in the future with the revegetation of the exposed sediments. These results indicate that Steed Pond could be left in its present condition (dry) without affecting suspended solids concentrations and associated uranium concentrations in Upper Three Runs Creek. 7 figs.

47315 **(INIS-BR—1197) Cesium-137 monitoring of aquatic and terrestrial environment in Goiania.** Godoy, J.N.O.; Guimaraes, J.R.D.; Gouvea, V.A.; Rochedo, E.R.R. (Instituto de Radioprotecao e Dosimetria, Rio de Janeiro (Brazil)). 1988. 8p. (In Portuguese). NTIS (US Sales Only), PC A02/MF A01. Order Number DE88703889/JAW.

During the Goiania radiological accident, aprox. 1200 Ci of Cs - 137 were inadvertently manipulated and an unknown fraction of this total was available for environmental dispertion during at least 6 weeks, before efficient remedial action could be undertaken. The main dispersion pathways were rainwater run-off and soil resuspension and further deposition. Cs-137 monitoring in the local environment started in the first week of October, including to date aprox. 1300 measurements of soil, vegetable (fruits and kitchen-gar-

dens), ground and drinking water, sediments and fish, aerosol, precipitation and external dose measurement with TL dosimeters, in the surroundings of the main contamination spots. Until the conclusion of de-contamination activities in late December, the ranges of Cs-137 in a 50m radius of evacuated areas were as follows: 10/sup 2/-10/sup 4/ Bq/Kg for surface soils and edible vegetables, 10/sup 0/-10/sup 1/mBq/m/sup 3/ in air and 10 Bq/l in all water types. River sediment and fish 5-10 Km downstream the accident are ranged respectively 10/sup 2/-10/sup 3/ and 10/sup 2//Kg. These data indicated the pathways and locations for intervention for further reduction of radiation exposure. This intervention consisted mainly in tree-tipping and surface soil removal.

47316 **(INIS-BR—1203) Considerations about soil decontamination in Goiania: doses the population at the first year and at long date.** Amaral, E.C.S.; Vianna, M.E.C.M.; Godoy, J.M.; Rochedo, E.R.R.; Campos, M.J.; Oliveira, J.P.; Reis, W.G.; Pires do Rio, M.A.; Pereira, J.C.A.; Romeiro, C.H. (Instituto de Radioprotecao e Dosimetria, Rio de Janeiro (Brazil)). 1988. 8p. (In Portuguese). NTIS (US Sales Only), PC A02/MF A01. Order Number DE88703895/JAW.

Values of the order of 10/sup 4/ to 10/sup 5/ Bq/Kg for the Cs-137 specific activity were observed for soils from regions within a radius of about 50 meters around the main focus. The dissemination was done by the wind and further deposition. However, it was also observed the disposal of contaminated housewaste at unused gardens nearby. It was found the soil profiles as an adequated method for decision on the soil layer to be removed. The in-soil Cs-137 migration presented the same shape whatever the specific activity deposited at the surface and in average 30% of the total activity has remained at the upper 1.5 cm layer over the first five months after the accident. The limits and procedures that have been adopted ensure a total dose to the critical group below 4 mSv for the first year and 0.68 mSv/a in average over the life-time above background.

47317 **(PNRI(C)-II-A—87008) Some radioactivity concentrations and ingestion dose projections arising from consumption of food containing Chernobyl contamination.** Paz, L.R. de la; Palattao, M.V.; Estacio, J.F.L.; Anden, A. (Philippine Nuclear Research Inst., Diliman, Quezon City). Apr 1987. 12p. NTIS (US Sales Only), PC A03/MF A01. Order Number DE88703801/JAW.

Doses arising from the ingestion of radioactive contamination coming from Chernobyl accident are calculated using various radioactivity limits adopted by different organizations after the accident. These are compared with that allowed in the Philippines. Projected concentrations of Cs-137 and Cs-134 in various food items in the affected countries, one month and one year after the accident are calculated using a model proposed by Boone, Ng and Palms. Except for food produced in one or two hot spots, the projected concentrations after one year are expected to return to within the range of pre-Chernobyl values. (Auth.) 12 refs.; 13 tabs.; 6 figs.

47318 **(WHC-SA—0180) The effect of waste package components on radionuclides released from spent fuel under hydrothermal conditions.** Rawson, S.A.; Neal, W.L.; Burnell, J.R. (Westinghouse Hanford Co., Richland, WA (USA)). 2 Dec 1987. Contract AC06-87RL10930. 13p. (CONF-871124—103). NTIS, PC A03/MF A01; 1; GPO Dep. Order Number DE88013677/JAW.

From Fall meeting of the Materials Research Society; Boston, MA, USA (30 Nov 1987).

The Basalt Waste Isolation Project has conducted a series of hydrothermal experiments to characterize waste/barrier/rock interactions as a part of its study of the Columbia River basalts as a potential medium for a nuclear waste repository. Hydrothermal tests of 3--15 months duration were performed with light water reactor spent fuel and simulated groundwater, in combination with candidate container materials (low-carbon steel or copper) and/or basalt, in order to evaluate the effect of waste package materials on spent fuel radionuclide release behavior. In all experiments, ^{14}C, ^{129}I, and ^{137}Cs occurred only as dissolved species, whereas the actinides occurred in 400 nm filtrates primarily as spent fuel particles. Actinide concentrations in 1.8 nm filtrates were below detection in steel-bearing experiments. In the system spent fuel + copper, apparent time-invariant concentrations of ^{14}C and ^{137}Cs were obtained, but in the spent fuel + steel system, the concentrations of ^{14}C and ^{137}Cs increased gradually throughout the experiments. In experiments containing basalt or steel + basalt, ^{137}Cs concentrations decreased with time. In tests with copper + basalt, ^{14}C and ^{129}I concentrations attained time-variant values and ^{137}Cs concentrations decreased. Concentrations for the actinides and fission products measured in these experiments were below those calculated from Federal regulations governing radionuclide release. 12 refs., 7 figs., 5 tabs.

47319 **Measurement of the natural radiation background level of Riyadh City.** Al-Kusayer, T.A.; Al-Haj, A.N. (King Saud Univ. (Saudi Arabia)). *Transactions of the American Nuclear Society;* **55**: 87-89(1987). (CONF-8711195—).

From American Nuclear Society winter meeting; Los Angeles, CA, USA (15 Nov 1987).

A gamma spectroscopy system was used to analyze the radionuclides in soil samples and to determine the cumulative radioactivity of terrestrial origin in the Riyadh City area. Minimal work has been done in the 1980s to measure the natural background radiation level in Saudi Arabia by using thermoluminescent dosimeters. The measurement of the natural radioactivity in the Riyadh area for the radionuclide concentration in becquerels per kilogram, the exposure rate arising from radionuclides in grays per hour, and the equivalent dose rate in sieverts per hour are the goals of this work. Soil samples were collected from 21 places in Riyadh City. Each site was sampled for two depth profiles, 0 to 5 cm and 5 to 15 cm. These measurements were taken before the Chernobyl accident, and in the absence of any measurements for that area in the past, this work can be considered in future work for a reference ^{137}Cs concentration in Riyadh soil to determine the ^{137}Cs increase in the soil after the Chernobyl accident.

5105 Site Resource And Use Studies

REFER ALSO TO CITATION(S) 47308, 47322

47320 **(UCRL—98880) Climate change: Effects on reef island resources.** Oberdorfer, J.A.; Buddemeier, R.W. (Lawrence Livermore National Lab., CA (USA); San Jose State Univ., CA (USA). Dept. of Geology). 27 Jun 1988. Contract W-7405-ENG-48. 5p. (CONF-880873—3). NTIS, PC A02. Order Number DE88014145/JAW.

From 6. international coral reef symposium; Townsville, Australia (8 Aug 1988).

The salinity, depth, quantity, and reliability of fresh groundwater resources on coral reef islands and coastlines are environmentally important parameters. Groundwater influences or controls the terrestrial flora, salinity, and nutrient levels in the near-shore benthic environment, the rate and nature of sediment diagenesis, and the density of human habitation. Data from a number of Indo-Pacific reef islands suggest that freshwater inventory is a function of rainfall and island dimensions. A numerical model (SUTRA) has been used to simulate the responses of atoll island groundwater to changes in recharge (precipitation), sea level, and loss of island area due to flooding. The model has been calibrated for Enjebi Island, Enewetak Atoll, where a moderately permeable, water-table aquifer overlies a high-permeability formation. Total freshwater inventory is a monotonic but nonlinear function of recharge. If recharge and island area are constant, rising sea level increases the inventory of fresh water by increasing the useful volume of the aquifer above the high-permeability zone. Flooding of land area reduces the total freshwater inventory approximately in proportion to the loss of recharge area. The most significant results of the model simulation, however, are the findings that the inventory of low-salinity water (and by extrapolation, potable water) is disproportionately sensitive to changes in recharge, island dimensions, or recharge. Island freshwater resources may therefore be unexpectedly vulnerable to climate change.

52 ENVIRONMENTAL SCIENCES, AQUATIC

5201 Basic Studies

REFER ALSO TO CITATION(S) 47338

47321 **Time and size at metamorphosis related to adult fitness in Ambystoma talpoideum.** Semlitsch, R.D.; Scott, D.E.; Pechmann, J.H.K. (Memphis State Univ., TN (USA)). *Ecology;* 69: No. 1, 184-192(Feb 1988).

The relationships among timing of metamorphosis, size at metamorphosis, and traits related to adult fitness were studied for 8 yr in the salamander Ambystoma talpoideum at a temporary pond. Among years, the modal time of metamorphosis and mean body size at metamorphosis were positively correlated with the date the pond dried. In years that the pond dried late, one group of larvae metamorphosed well before the pond dried, whereas the other group metamorphosed just before pond drying. Mean body size of late-metamorphosing individuals was not greater than that of individuals metamorphosing early. Early-metamorphosing males and females were larger at first and second reproduction than were late-metamorphosing individuals. Independent of timing of metamorphosis, larger juveniles at metamorphosis were also larger adults at first reproduction. Age at first reproduction for males was not associated with timing of or size at metamorphosis but large early-metamorphosing females reproduced at a younger age than did small early-metamorphosing females. Neither time of metamorphosis nor size at metamorphosis was associated with survival to first reproduction. These results demonstrate a direct relationship between phenotypic variation generated in the larval stage and adult traits closely associated with an individual's fitness.

5202 Chemicals Monitoring And Transport

REFER ALSO TO CITATION(S) 46750, 47398, 47424

47322 **(BR—85(7.17)) The Detroit River, Michigan: An ecological profile.** Manny, B.A.; Edsall, T.A.; Jaworski, E. (National Fisheries Research Center-Great Lakes, Ann Arbor, MI (USA)). Apr 1988. 99p. Unlimited audience, publicly available to Fish and Wildlife Service, 1010 Gause Blvd, Slidell, LA 70458.. Order Number TI88013009/JAW.

A part of the connecting channel system between Lake Huron and Lake Erie, the Detroit River forms an integral link between the two lakes for both humans and biological resources such as fish, nutrients, and plant detritus. This profile summarizes existing scientific information on the ecological structure and functioning of this ecosystem, river hydrology, lower trophic-level biotic components, native and introduced fishes, waterfowl use, ecological interrelationships, commercial and recreational uses of the river, and current management issues. Despite urbanization, the river still supports diverse fish, waterfowl, and benthic populations. Management issues include sewer overflows; maintenance dredging for navigation and port activities; industrial discharges of potentially hazardous materials; and wetland, fishery, and waterfowl protection and enhancement. 210 refs., 30 figs., 41 tabs.

47323 **(DOE/ER/60627—1) The flux and recycling of bioactive substances in the surface sediments of the deep basins off southern California: Progress report, November 1987--July 1988.** Jahnke, R.A. (Skidaway Inst. of Oceanography, Savannah, GA (USA)). 1 Jul 1988. Contract FG09-88ER60627. 4p. NTIS, PC A02/MF A01; 1; GPO Dep. Order Number DE88014251/JAW.

Goals of this project are to develop an understanding of the processes responsible for the recycling of biogenic debris in the surface sediments of Santa Monica Basin and to quantitatively determine the rate at which dissolved chemicals exchange across the sediment-bottom water boundary. This information will provide fundamental information about organic matter decomposition and oxidation at the seafloor as well as provide a quantitative minimum estimate of the lateral input of organic matter to the deep basin from the adjacent continental shelf. We developed a preliminary organic carbon budget for the seafloor based on pore water and in situ benthic chamber flux measurements. The latter were performed with the MANOP Bottom Lander free-vehicle which was developed during the NSF sponsored Manganese Nodule Program.

47324 **(DOE/MC/11076—2454) Groundwater restoration field test at the Hoe Creek underground coal gasification site.** Nordin, J.S.; Barrash, W.; Nolan, B.T. (Western Research Inst., Laramie, WY (USA)). Feb 1988. Contract FC21-86MC11076. 30p. NTIS, PC A03/MF A01; 1; GPO Dep. Order Number DE88008735/JAW.

Three underground coal gasification burns were conducted at the Hoe Creek Site in the Powder River Basin. Some contaminants were released in the groundwater. The Department of Energy (DOE) analyzed the water from a network of wells. Two million gallons of groundwater were pumped from wells adjacent to the Hoe Creek II underground coal gasification cavity, passed through filters and carbon adsorbers, and reinjected into the cavity. Phenol was the target compound of the water treatment system. The phenol concentration pumped from well WS-10 decreased from 974 parts per billion (ppB) when treatment began on July 2, 1987, to about 200 ppB when treatment ceased on August 29, 1987. Phenol concentrations pumped from well WS-22 fluctuated during the tests, but they decreased to the 150 to 200 ppB range by the time treatment was terminated. The phenol concentration of treated water reinjected into the Hoe Creek II cavity was below detectable limits (less than 20 ppB). Pumping rates were about 18 gallons per minute (gpm) from well WS-10 and 6 to 8 gpm from well WS-22. Hoe Creek is located approximately 20 miles southwest of Gillette, Wyoming. 12 refs., 5 figs., 8 tabs.

47325 **(GKSS—88/E/6) Chlorinated hydrocarbons in sediments of the Elbe River and the Elbe estuary.** Eder, G.; Ernst, W.; Sturm, R. (GKSS-Forschungszentrum Geesthacht G.m.b.H., Geesthacht-Tesperhude (Germany, F.R.)). 1988. 11p. Special print from Chemosphere (1987) Vol. 16(10-12) p. 2487-2496.

Eight sediment samples collected between Hamburg and Cuxhaven were analysed for organic micropollutants. Using three different methods the following compounds were determined: α-HCH, γ-HCH, HCB, PCB, DDT-family, pentachlorobenzene and octachlorostyrene.

47326 **(LBL—23430) Radon and remedial action in Spokane River Valley homes: Final report to the Bonneville Power Administration: Volume 1, Experimental design and data analysis.** Turk, B.H.; Prill, R.J.; Fisk, W.J.; Grimsrud, D.T.; Moed, B.A.; Sextro, R.G. (Lawrence Berkeley Lab., CA (USA)). Dec 1987. Contract AC03-76SF00098;AI79-83BP12921. 116p. NTIS, PC A06/MF A01; 1; GPO Dep. Order Number DE88014032/JAW.

Fifty-seven percent of 46 residences surveyed in the Spokane River Valley/Rathdrum Prairie region of eastern Washington/Northern Idaho had heating season indoor radon concentrations above the Bonneville Power Administration Mitigation Action Level of 5 pCi/L, while 65% were above US Environmental Protection Agency guideline of 4 pCi/L. Six of these measurements were greater than 20 pCi/L. Fourteen houses from this region and one house from Vancouver, Washington were selected for more intensive monitoring and testing of radon remedial action techniques. The primary radon source was pressure-driven flow of soil gas containing moderate radon concentrations (283 to 673 pCi/L) from the highly permeable (10/sup minus 10/ to 10/sup minus 13/ m^2) soils surrounding the house substructures. Radon from other sources, including potable water and building materials, was negligible. In the high radon homes, winter indoor levels averaged 12.6 times higher than summer, while a group of low radon homes averaged only 2.5 times higher. Several radon control strategies proved to be effective. 63 refs., 47 figs., 17 tabs.

47327 **(LBL—24638) Radon and remedial action in Spokane River Valley homes: Volume 2, Appendices to LBL-23430: Final report.** Prill, R.J.; Turk, B.H.; Fisk, W.J.; Grimsrud, D.T.; Moed, B.A.; Sextro, R.G. (Lawrence Berkeley Lab., CA (USA)). Dec 1987. Contract AC03-76SF00098;AI79-83BP12921. 82p. NTIS, PC A05/MF A01; 1; GPO Dep. Order Number DE88014042/JAW.

This collection of appendices supports the text in Volume I, Lawrence Berkeley Laboratory Report No. 23430. Volume II contains detailed information that is not contained in Volume I, including the following: 1) a description of radon measurement techniques; 2) a comprehensive chronology of house operating conditions, mitigation systems configurations and corresponding radon concentrations; 3) a summary of indoor and outdoor formaldehyde, water vapor, and respirable suspended particle concentrations, and ventilation rates; 4) a floor plan for each house detailing sampling sites and mitigation system installations; and 5) diagnostic maps of radon grab sampling. 37 figs., 2 tabs.

47328 **(LBL—24657) Ground conductivity measurements adjacent to the Kesterson Ponds 1, 2, and 5: Final report.** Goldstein, N.E.; Alumbaugh, D.; Benson, S.M. (Lawrence Berkeley Lab., CA (USA)). Apr 1988. Contract AC03-76SF00098. 25p. NTIS, PC A03/MF A01; 1; GPO Dep. Order Number DE88014041/JAW.

In this study we have attempted to map the drainwater plume using commercially available electromagnetic instruments calibrated by the manufacture to give ground conductivity readings directly. We employed the Geonics EM31 and EM34-3 instruments, which are described in a later section. We had also planned to use the Geonics EM16R, a VLF radiofrequency device, but hard ground conditions made it too difficult to emplace electrodes without damaging them. Analysis of water samples obtained from many shallow holes within the Reservoir show that conductivities of the drainwater are several times greater than those of the native groundwater. Specific conductances of the native groundwater are in the range of 300 to 400 milliSiemens per meter (mS/m), whereas conductivities of contaminated groundwater range up to 1000 to 1700 mS/m because of the high Na, Cl, and SO{sub 4} concentrations. Saline agricultural drainwater used to flood the Kesterson ponds has entered the shallow sandy aquifer beneath the ponds by seeping through the near-surface layer of fine-grained sediments. The plume of infiltrating drainwater is expected to migrate eastward, partly as a result of groundwater mounding, caused by filling the Kesterson ponds, and partly as a result of the prevailing direction of regional groundwater flow.

47329 **(PB—88-203278/XAB) National Swedish programme for monitoring of environmental quality. Open-sea Program. Report from the activities in 1987.** Carlberg, S.R.; Engstroem, S.; Fonselius, S.H.; Fyrberg, L.; Palmen, H. (Sveriges Meteorologiska och Hydrologiska Inst., Stockholm). Mar 1988. 64p. (SMHI-RO—7-1988). NTIS, PC E04/MF A01.

The report describes the activities and results from 1987 within the Open-Sea Program of the National Swedish Monitoring Program, PMK. Two regular oceanographic cruises were carried out to the Baltic, two plus one supplementary cruises to the Gulf of Bothnia, three in the Kattegat and five in the Sound. Standard oceanographic parameters including nutrients were analyzed and various biological samples were taken, including fish and mussel samples for analysis of harmful substances. From spring to autumn a negative temperature anomaly of 2-4C was observed in the Kattegat and the Baltic. In the Gotland Deep the hydrogen sulphide has now resided for 10 continuous years in the deep water.

47330 **(PB—88-206727/XAB) Anaerobic treatment of pulp and paper mill effluent.** Venter, J.S.M. (National Timber Research Inst., Pretoria (South Africa)). Feb 1987. 27p. (CSIRO/HOUT—63). NTIS, PC E05/MF E05.

Summary in Afrikaans; North American Continent sales only.

The principles of anaerobic treatment of pulp and paper mill effluent are discussed with special reference to the advantages, disadvantages, different approaches, hardware, and process control. Although the process is used mainly in the food-processing industry, its use in the pulp and paper industry is gaining ground. A prerequisite for its use is that the effluent stream should have a high concentration of not less than 2500 mg/l COD. Loading rates of up to 20-kg COD/cu m/day has been achieved. The use of an anaerobic-fermentation process followed by aerobic treatment can yield COD removals of better than 98%.

47331 **(PNL-SA—15217, pp 167-173) Complex mixtures in the aquatic environment.** Bull, R.J.; Meier, J.R.; Kopfler, F. (Washington State Univ., Pullman, WA (USA)). 1987. NTIS, PC A99/MF A01. Order Number DE88007332/JAW. (CONF-851027—).

From 24. Hanford life sciences symposium and environmental research on complex organic mixtures; Richland, WA, USA (20 Oct 1985).

Chlorination of drinking water has been shown to produce a wide variety of new chemical species. These products are formed from organic material in the source water that is primarily of natural origin. Aquatic humic and fulvic acids comprise a large percentage of this background organic substrate for chlorination reactions. The heterogeneity of fulvic and humic acids from different sources and the low concentrations present in water make systematic study of the toxicological properties of by-products unmanageable. Consequently, the authors chose to obtain a large batch of humic acid that would provide a consistent substrate for chlorination reactions. This has allowed close coupling of screening assays and analytical chemical work to characterize the compounds responsible for biological activity. Furthermore, it provides a consistent source of material to allow confirmation of screening results in intact animals. Chemical analyses of typical drinking waters serve to confirm the appropriateness of this model system. To date, work has concentrated on the production of direct-acting mutagenic and carcinogenic chemicals by chlorination of humic acid. Prominent chemicals identified that contribute to the mutagenic activity include a series of halogenated acetonitrites, aldehydes and ketones. Among the more potent mutagens are 2-chloropropenal, 2,3,3-trichloropropenal and 1,3-dichloropropanone. So far, only about 7% of the total mutagenic activity can be accounted for analytically.

47332 **(PNL-SA—15217, pp 487-499) Transport mechanisms for organic contaminants in coastal plain sediments.** Looney, B.B. (Savannah River Lab., Aiken, SC (USA)). 1987. NTIS, PC A99/MF A01. Order Number DE88007332/JAW. (CONF-851027—). Contract AC09-76SR00001.

From 24. Hanford life sciences symposium and environmental research on complex organic mixtures; Richland, WA, USA (20 Oct 1985).

Recent hydrogeological investigations at manufacturing and waste sites showed that these operations often contaminate the unsaturated zone and ground water with organic solvents. The success of remedial action depends on accurate assessment of the sediment/solution/organic interaction which governs the strength of the source in the unsaturated zone and the transport rate of organics in ground water. There is currently a paucity of data related to sorption and transport/retardation mechanisms for organics. Field observations and a preliminary soil-column study at the authors laboratory allowed measurement of partition coefficients under conditions that approximate the underground environment more closely than classical shake-flask isotherms. The equilibria between the contaminant solution and solid phases could be described by the three equations given. The K/sub rho/ estimated from laboratory or field observations is actually a complex relationship, in which the apparently dissolved material is the sum of the truly dissolved material and the contaminant associated with other dissolved organic matter. The apparently bound material is the sum of the contaminants associated with the organic and inorganic fractions of the particles. The K/sub rho/ can be described mathematically, and contaminant partitioning in an aqueous solution containing a complex mixture of organics can be estimated using high-performance liquid chromatography.

47333 (PNL-SA—15217, pp 501-573) **Modeling the vertical transport and fate of low-solubility chemicals in a simple aquifer: comparison of three approximation methods.** Lindstrom, F.T.; Piver, W.T. (National Institute of Environmental Health Sciences, Research Triangle Park, NC (USA)). 1987. NTIS, PC A99/MF A01. Order Number DE88007332/JAW. (CONF-851027—).

From 24. Hanford life sciences symposium and environmental research on complex organic mixtures; Richland, WA, USA (20 Oct 1985).

This paper describes a mathematical model to simulate vertical transport of low-water-solubility chemicals in a simple, unconfirmed aquifer. The authors have not solved the resulting nonlinear, coupled, parabolic transport equations for moisture, heat and chemical with dynamic coupling conditions at the atmosphere-soil interface because of their extreme complexity. However, an approximate solution, via numerical methods, can be obtained. They compare three methods of approximating a numerical solution for several realistic soil-column situations and an initial distributed source of surface chemical. The first two methods are based on finite difference; the third is the method of finite elements.

47334 (PNL-SA—15217, pp 575-589) **Investigation of the significance of convective transport in river sediments.** Savant, S.A.; Reible, D.D.; Thibodeaux, L.J.; Gipson, G.S.; Boyle, J.D. (Louisiana State Univ., Baton Rouge (USA)). 1987. NTIS, PC A99/MF A01. Order Number DE88007332/JAW. (CONF-851027—).

From 24. Hanford life sciences symposium and environmental research on complex organic mixtures; Richland, WA, USA (20 Oct 1985).

The potential for significant convective transport in riverbed sediment was investigated through a series of preliminary laboratory and numerical experiments. Transport of pollutants, and oxygen and other nutrients, is generally considered to result from diffusional processes in the absence of a mean hydraulic gradient. However, because of the uneven surface in most river beds, convective transport resulting from local variations in bed pressure might be significant. Pressure differences on the order of 100 N/m^2 can be expected between upstream and downstream sides of surface roughness elements in a typical stream. Experiments in a recirculating flume with a coarse-gravel sediment layer indicated that the pressure difference was sufficient to cause significant convective transport. Fluid velocities within the model river were observed by trajectory analysis of nigrosine dye. Although convective velocities induced within the gravel were about two orders of magnitude smaller than the overlying freestream flow, they were about seven orders of magnitude greater than estimated diffusive transport rates. To expand these results to a more realistic stream system, the experiments were modeled, assuming that induced flow velocities and applied pressures were related by Darcy's Law. Equations governing induced flow were solved via the boundary integral method to take advantage of its flexibility, high resolution and reduced memory requirements. The model, after validation for gravel-bed experiments, was used to predict convective flows in various typical river sediments. Numerical results indicate that induced convective transport cannot be neglected in many sediments. Experimental verification of these results is continuing.

47335 (PNL-SA—15217, pp 643-655) **Contamination and toxicity of the sea-surface microlayer of Puget sound.** Hardy, J.T.; Crecelius, E.A.; Long, E.; Kiesser, S.L.; Stubin, A.I.; Gurtisen, J.M.; Apts, C.W. (Battelle, Marine Research Lab., Sequim, WA (USA)). 1987. NTIS, PC A99/MF A01. Order Number DE88007332/JAW. (CONF-851027—).

From 24. Hanford life sciences symposium and environmental research on complex organic mixtures; Richland, WA, USA (20 Oct 1985).

Microlayer and bulk water samples were collected from a rural bay, the central Sound, and three urban bays in Puget Sound for chemical and toxicological analyses. Fertilized neustonic eggs of sand sole (Psettichthys melanostictus), were exposed to the collected waters during their first week of embryonic and larval development. Exposure of embryos to microlayer samples from several urban bay sites, which contained elevated contamination compared to the rural site and/or central Puget Sound, resulted in significant increases in: 1) development time (delayed hatching), 2) embryo mortality, and 3) kyphosis (bent spine) in hatched larvae. The authors found high concentrations of polynuclear aromatic and chlorinated hydrocarbons in the microlayer of urban bays; concentrations sometimes exceeded water quality criteria by several orders of magnitude. Several subsurface bulk water samples collected below highly contaminated surfaces showed no detectable contamination. Microlayer samples that were most contaminated (notably with polycyclic aromatic hydrocarbons) were most toxic; up to 100% mortality was observed in some samples. Monitoring the microlayer provides a sensitive indicator of relatively recent environmental contamination. The spatial and temporal extent of sea-surface pollution and its effects on fishery resources remain to be determined.

47336 (UCRL—21008-Vol.4-Pt.1) **Evaluation of military field-water quality: Volume 4, Health criteria and recommendations for standards: Part 1, Chemicals and properties of military concern associated with natural and anthropogenic sources.** Daniels, J.I. (ed.). (Lawrence Livermore National Lab., CA (USA)). Feb 1988. Contract W-7405-ENG-48. 281p. NTIS, PC A13/MF A01; 1; GPO Dep. Order Number DE88013813/JAW.

The purpose of this report is to develop drinking water standards for field-water constituents and properties of military concern that are naturally occurring or anthropogenically introduced under peacetime conditions. The recommended standards are applicable only to military personnel deployed in the field and they are meant to protect against performance-degrading effects resulting from the ingestion of field-water. Standards are recommended that address both short-term (up to 7 d) and long-term (up to 1 y) field-water consumption at rates of 5 and 15 L/d. Turbidity and color are the physical properties of concern because they can adversely impact the organoleptic quality (e.g., taste, odor, or appearance) of field water and thereby lead to reduced water consumption and subsequent involuntary dehydration, which can degrade performance. Total dissolved solids, chloride, magnesium, sulfate, inorganic arsenic, cyanide, the pesticide lindane, and metabolites of aquatic algae and associated bacteria (i.e., geosmin and methylisoborneol) are the chemical constituents of concern because they can be responsible for degrading performance directly as a consequence of their toxic properties and/or indirectly by adversely affecting the organoleptic quality of field water, which can result in reduced water consumption and in increased risk of dehydration.

47337 **Hydrologic detection of abandoned wells near proposed injection wells for hazardous waste disposal.** Javandel, I.; Tsang, C.F.; Witherspoon, P.A.; Morganwalp, D. (Lawrence Berkeley Lab., CA (USA)). *Water Resources Research;* 24: No. 2, 261-270(Feb 1988). Contract AC03-76SF00098.

Deep saline aquifers are being used for disposal of hazardous liquid wastes. A thorough knowledge of the competency of such aquifers and their confining geologic beds in permanently isolating the hazardous substances is the key to successful disposal operations. Characterization of such systems, and in particular the detection of any conduit that may permit hydraulic communication between the host aquifer and nearby freshwater aquifers, must be carried out prior to the initiation of disposal projects. In deep, multi-aquifer systems, leaky faults, abandoned wells, highly conductive fractures, or shear zones may all provide leakage paths. If not initially detected,such conduits may show no apparent effect until contaminants in the freshwater aquifer reach detectable levels at the discharge point. By then, of course, detection is generally too late. This paper is an attempt to address the problem of initial detection of improperly plugged or open abandoned wells. A new analytic solution has been derived to calculate the amount of leakage from an abandoned well and the corresponding drawdown at monitoring wells. A method is proposed that can be used to detect such deep abandoned wells in the area of influence of a proposed deep injection well in a multiple-aquifer system.

5203 Radioactive Materials Monitoring And Transport

REFER ALSO TO CITATION(S) 46414, 46415, 46416, 46417, 46418, 46419, 46420, 46421, 46439, 47314, 47381, 47424

47338 (DOE/CH/10255—T1) An investigation of trace metals in the aqueous environment: Final report, January 1, 1986-December 31, 1987. Wilson, B. (Texas Southern Univ., Houston (USA)). 10 May 1988. Contract FG02-86CH10255. 28p. NTIS, PC A03. Order Number DE88014030/JAW.

The primary purpose of this project was to examine trace metals and radionuclides contents in aqueous (water column and interstitial water of the bottom sediments) and soil samples near a local coal- fired power plant. The following trace metals may be found in the aqueous environment: Ba, Cd, Co, Cr, Cu, Fe, Hg, Mn, Mo, Pb, Ti, V, and Zn. The natural radionuclides ^{40}K, ^{210}Pb, ^{230}Th, ^{226}Ra, ^{236}U, and /sup 238)U may be released in the fly ash of coal fired power plants or as nuclear test weapon waste products. 8 refs., 3 figs., 9 tabs.

47339 (IAEA-R—4029-F) Isotopic hydrological studies carried out on the Karst water system. Final report for the period December 1984 - December 1987. Longinelli, A. (Trieste Univ. (Italy). Inst. of Mineralogy and Petrology). (International Atomic Energy Agency, Vienna (Austria)). Mar 1988. 12p. NTIS (US Sales Only), PC A03/MF A01. Order Number DE88703828/JAW.

The isotopic composition and temperature of many karst springs in the area of Trieste (Italy) have been measured for about three and a half years. During the same period the isotopic composition of precipitation has also been systematically studied. The isotopic composition of springs generally shows variations which are markedly shifted in time with respect to those of precipitation. In most of the springs the heavy isotope contents of winter samples are the highest of the whole year. On the contrary, summer samples normally show quite negative δ-values, the most negative of which often refer to the last summer months. The data obtained are explained in terms of variable mixing of waters from two main reservoirs. The less negative reservoir (in terms of δ) is recharged by "local" meteoric waters falling on the westernmost section of the karst area whose mean elevation is about 400 m a.s.l. The most negative reservoir is probably recharged by meteoric waters falling on the Slovenian section of the karst, whose mean elevation is about 800-900 m a.s.l. At least in the case of some of the northernmost karst springs, it is likely that a third water system, basically fed by the Isonzo river, flowing north of the karst area, could interfere with the previously mentioned reservoirs, partially controlling the outflow of some springs. 6 figs.

47340 (IC—88/81) Yellow substance (gelbstoff). Medina, A. (International Centre for Theoretical Physics, Trieste (Italy)). Apr 1988. 17p. NTIS (US Sales Only), PC A03/MF A01. Order Number DE88703855/JAW.

The different values of the mean slope (S) of the absorption coefficient a(λ) of gelbstoff (yellow substance) for each region under the same hydrological conditions and the correlation between the quantity of absorption (CA) of gelbstoff and sea water parameter is discussed. 12 refs, 6 figs, 3 tabs.

47341 (SNV—3213) Radionuclides in Bentic Algae. One years study in biotest basin, Forsmark. Notter, M.; Snoeijs, P. (National Swedish Environmental Protection Board, Solna). Sep 1986. 33p. (In Swedish). NTIS (US Sales Only), PC A03/MF A01. Order Number DE88753661/JAW.

Bentic micro-algae (mainly consisting of diatoms) were taken from 4 sites in the discharge area of the Forsmark Nuclear Power Station (Sweden) and from 1 site in the cooling water intake channel of the power station. Samples were taken every third week during 1984. The micro-algae were brushed of a 0.1-0.15 m/sup 2/ area on stones collected from the hydrolittoral zone. Radionuclide concentration was measured as gamma radiation with a Ge-detector. Fission products from the power plant cooling water can easily be detected in the micro-algae. We show that benthic diatom assemblages are good indicators for radionuclides; good correlations were found between radionuclide concentration in the algae and the discharge from the power plant. The best correlations were obtained if the accumulated discharge for the 15 days before sampling was used in the calculations. Of the investigated radionuclides, Co-60 and Zn-65 show significant relationships between concentration in the algae and discharge for 2 site, Ag-110m for 3 sites and Mn-54 for 1 site. No correlations were found for the site in the intake channel. The results show differences which depend on whether calculations were done for total, particulate or dissolved fractions of the radionuclides. There are indications that there is considerable recirculation of the radionuclides within the algal assemblages, and the recirculation from the outlet of the Biotest basin to the intake channel is of about 10%. In this report we also present a budget for the total amount of radionuclides in the Biotest Basin for 1984. The highest amounts of radionuclides in diatoms were found during late winter and early spring, associated with the large diatom blooms at that time of the year in the basin. (authors).

5205 Site Resource And Use Studies

REFER ALSO TO CITATION(S) 47220, 47322, 47328, 47423

53 ENVIRONMENTAL-SOCIAL ASPECTS OF ENERGY TECHNOLOGIES

5301 Social And Economic Studies

47342 (DOE/ER/60529—18) Effect of behavioral strategies and activity on thermal comfort of the elderly. Cena, K.M.; Spotila, J.R.; Ryan, E.B. (Drexel Univ., Philadelphia, PA (USA). Dept. of Bioscience and Biotechnology). [1988]. Contract FG02-87ER60529;AC09-76SR00819. 21p. NTIS, PC A03/MF A01; 1; GPO Dep. Order Number DE88014308/JAW.

A field survey indicated that 101 elderly subjects (mean age 73.4 years) of good health living independently in Hamilton, Ontario, maintained comfort in winter 1985-1986 with a constant mean clothing insulation of 0.8 clo and mean indoor air and operative temperatures at 21,2{degree}C (70.2 F) and 21.5{degree}C (70.7 F), respectively. The subjects scored 83.5 on the Self-Evaluation of Life Function (SELF) scale. Mean activity level at rest was 1.5 met and during periods of light exercise (walking at 1.3 mph, 2 km hr -1) and light domestic household work was 1.9 met. The subjects mean thermal comfort vote at rest was -0.1, very close to a thermal sensation of neutrality (0.0 on a scale from -3 tp +3). This agrees with corresponding measurement (mean of -0.2) of Predicted Mean Vote (PMV) performed with a thermal comfort meter based on the Fanger Comfort Equation. Their thermal comfort vote and PMV during the two periods of increased activity were the same, 0.03. 20 refs., 6 figs., 4 tabs.

5302 Assessment Of Energy Technologies

47343 (DOE/EIS—0125-F-Vol.2) Intertie development and use: Final environmental impact statement: Volume 2, Comments and responses: Part 1, IDU draft EIS, Part 2, Hydro operations information paper, Part 3, Revised Intertie access policy. (USDOE Bonneville Power Administration, Portland, OR). Apr 1988. 230p. NTIS, PC A10/MF A01. Order Number DE88008509/JAW.

The Bonneville Power Administration (BPA) has identified the need to enable short- and long-term contractual sales of federal power surplus to Northwest loads and to manage other interregional transfers of power over the Pacific Northwest/Pacific Southwest Intertie. There are three proposed options: to increase the capacity of the Intertie; to adopt a Long Term Intertie Access Policy (IAP), which will set the ground rules for use of the Intertie by utilities other than BPA for short- and long-term transmission of surplus power to California; and options whereby BPA would promote, through its access policies and marketing efforts, various types and levels of firm power marketing between the Northwest and California. The LTIAP also addresses access to the Intertie for new resources, access as it relates to the Administrator's efforts to

enhance fish and wildlife and access to the Intertie by extraregional utilities. Volume two contains public comments and responses.

47344 **(ORNL/TM—10746) Approach to uncertainty in risk analysis.** Rish, W.R. (Oak Ridge National Lab., TN (USA)). Aug 1988. Contract AC05-84OR21400. 143p. NTIS, PC A07/MF A01; 1; GPO Dep. Order Number DE88015332/JAW.

In the Fall of 1985 EPA's Office of Radiation Programs (ORP) initiated a project to develop a formal approach to dealing with uncertainties encountered when estimating and evaluating risks to human health and the environment. Based on a literature review of modeling uncertainty, interviews with ORP technical and management staff, and input from experts on uncertainty analysis, a comprehensive approach was developed. This approach recognizes by design the constraints on budget, time, manpower, expertise, and availability of information often encountered in "real world" modeling. It is based on the observation that in practice risk modeling is usually done to support a decision process. As such, the approach focuses on how to frame a given risk modeling problem, how to use that framing to select an appropriate mixture of uncertainty analyses techniques, and how to integrate the techniques into an uncertainty assessment that effectively communicates important information and insight to decision-makers. The approach is presented in this report. Practical guidance on characterizing and analyzing uncertainties about model form and quantities and on effectively communicating uncertainty analysis results is included. Examples from actual applications are presented.

55 BIOMEDICAL SCIENCES, BASIC STUDIES

5501 Behavioral Biology

REFER ALSO TO CITATION(S) 46728

5502 Biochemistry

REFER ALSO TO CITATION(S) 46291, 46292, 46467

47345 **(DOE/ER/13516—T2) [Analysis of cyanobacterial photosystem II genes by cloning and mutagenesis]: Progress report.** (Missouri Univ., Columbia (USA)). 1988. Contract FG02-86ER13516. 10p. NTIS, PC A02/MF A01; 1; GPO Dep. Order Number DE88013962/JAW.

The major goal of this current proposal was to isolate, clone, sequence and mutagenize specific proteins associated with the photosynthetic membrane and photosystem II (PSII) in cyanobacteria. We have made great progress toward most of our goals and we have also gone off in some important new directions. The analysis of photosystem II proteins led us to investigate the growth of cyanobacteria under iron-deficient conditions and to detect a number of new proteins involved in the photosynthetic membrane. In addition, this work led us to isolate proteins that are localized in the cytoplasmic membrane or in the cell wall membrane. These studies have tremendously enriched our knowledge of membrane structure and, at the same time, have enabled us to probe cyanobacterial membranes with increased precision. 11 refs.

47346 (INIS-BR—1164, pp 34) **SAXS studies of crotamine solutions at pH=4.5.** Beltran, J.R.; Mascarenhas, Y.P.; Craievich, A.F.; Laure, J. (Sao Paulo Univ., Sao Carlos, SP (Brazil). Inst. de Fisica e Quimica; Sao Paulo Univ., Ribeirao Preto (Brazil). Faculdade de Medicina). 1987. NTIS (US Sales Only), PC A09/MF A01. Order Number DE88703566/JAW. (CONF-8705181—).

From 10. national meeting on condensed matter physics; Caxambu, Brazil (5 May 1987).

47347 **Dynamic programming algorithm for finding alternative RNA secondary structures.** Williams, A.L. Jr.; Tinoco, I. Jr. (Univ. of California, Berkeley (USA)). *Nucleic Acids Research;* 14: No. 1, 299-314(10 Jan 1986).

Dynamic programming algorithms that predict RNA secondary structure by minimizing the free energy have had one important limitation. They were able to predict only one optimal structure. Given the uncertainties of the thermodynamic data and the effects of proteins and other environmental factors on structure, the optimal structure predicted by these methods may not have biological significance. The authors present a dynamic programming algorithm that can determine optimal and suboptimal secondary structures for an RNA. The power and utility of the method is demonstrated in the folding of the intervening sequence of the rRNA of Tetrahymena. By first identifying the major secondary structures corresponding to the lowest free energy minima, a secondary structure of possible biological significance is derived.

47348 **Statistical method for correlating tRNA sequence with amino acid specificity.** Atilgan, T.; Nicholas, H.B. Jr.; McClain, W.H. (Univ. of Wisconsin, Madison (USA)). *Nucleic Acids Research;* 14: No. 1, 375-387(10 Jan 1986).

A statistical method for finding the nucleotide positions in tRNA sequences that correlate with amino acid specificity has been developed. The procedure involves finding the subset of nucleotide positions and groups of positions where the marginal density of one amino acid tRNA class does not overlap that of any other amino acid class. The procedure is an application of a statistical method know as the Expectation Maximization algorithm.

5504 Genetics

47349 **(GAO/RCED—88-64BR) Biotechnology: Role of institutional biosafety committees.** (General Accounting Office, Washington, DC (USA). Resources, Community and Economic Development Div.). 1987. 44p. General Accounting Office, P.O. Box 6015, Gaithersburg, MD 20877.

Universities, companies, and other organizations using recombinant deoxyribonucleic acid technology in laboratories established biosafety committees to implement safety guidelines issued by the National Institutes of Health for the conduct of recombinant DNA research. This report focuses on (1) the membership of the biosafety committees, (2) the diversity of their functions and activities, (3) their implementations of the NIH guidelines for research involving recombinant DNA molecules, and (4) their role in overseeing the use of genetically engineered organisms in the environment.

47350 **GenBank genetic sequence databank.** Bilofsky, H.S.; Burks, C.; Fickett, J.W.; Goad, W.B.; Lewitter, F.I.; Rindone, W.P.; Swindell, C.D.; Tung, C.S. (BBN Laboratories, Cambridge, MA (USA)). *Nucleic Acids Research;* 14: No. 1, 1-4(10 Jan 1986).

The GenBank Genetic Sequence Data Bank contains over 5700 entries for DNA and RNA sequences that have been reported since 1967. This paper briefly describes the contents of the database, the forms in which the database is distributed, and the services offered to scientists who use the GenBank database.

5505 Metabolism

REFER ALSO TO CITATION(S) 46234, 46307

47351 **Influence of pH on microbial hydrogen metabolism in diverse sedimentary ecosystems.** Goodwin, S.; Conrad, R.; Zeikus, J.G. (Univ. of Wisconsin, Madison (USA)). *Applied and Environmental Microbiology;* 54: No. 2, 590-593(Feb 1988). Contract FG02-85ER13376.

Hydrogen transformation kinetic parameters were measured in sediments from anaerobic systems covering a wide range of environmental pH values to assess the influence of pH on hydrogen metabolism. The concentrations of dissolved hydrogen were measured and hydrogen transformation kinetics of the sediments were monitored in the laboratory by monitoring hydrogen consumption progress curves. The hydrogen turnover rate constants (k/sub t/) decreased directly as a function of decreasing sediment pH, and the maximum hydrogen uptake velocities (V/sub max/) varied as a function of pH within each of the trophic states. Conversely, the

half-saturation concentrations (K/sub m/) were independent of pH. The steady-state hydrogen concentrations were at least 2 orders of magnitude lower than the half-saturation constants for hydrogen uptake. Dissolved hydrogen concentrations were at least fivefold higher in sediments from eutrophic systems than from oligotrophic and dystrophic systems. The rates of hydrogen production determined from the assumption of steady state decreased with sediment pH. These data indicate that progressively lower pH values inhibit microbial hydrogen-producing and -consuming processes within sedimentary ecosystems.

5506 Medicine

REFER ALSO TO CITATION(S) 47374

47352 **(CERN-EP—87-172) Spallation produced radioisotopes for nuclear medical application.** Beyer, G.J.; Novgorodov, A.F.; Roesch, F.; Ravn, H.L. (European Organization for Nuclear Research, Geneva (Switzerland); Zentralinstitut fuer Kernforschung, Rossendorf bei Dresden (German Democratic Republic); Joint Inst. for Nuclear Research, Dubna (USSR)). 22 Sep 1987. 29p. (CONF-870490—3). NTIS (US Sales Only), PC A03. Order Number DE88013852/JAW.

From International Atomic Energy Agency coordinated research project on isotope production for medical applications; Tokyo, Japan (20 Apr 1987).

Spallation reaction opens new additional possibilities for production of a number of medical useful isotopes. In some cases all the present world demand is produced through spallation. Because of the high transmission of targetmaterials for medium or high energy protons lower cross-sections bay be more than compensated by using massive targets. The unspecific nuclear reaction as well as the radiochemical processing of such massive targets lead to several difficulties. New ways for processing of large spallation targets are required. The possibilities of modern ISOL-techniques (ISOL {equals} Isotope Separator on-line{quotes} for the production of medical useful radioisotopes will be discussed in some detail. Corresponding cross- section data are reviewed and discussed in relation to physico- chemical data requirements. the radioisotopes 81 Rb, 82 Sr, 123 I, 167 Tm and 211 At are discussed. 65 refs, 11 figs, 1 tab.

47353 (INIS-BR—1164, pp 75) **Control system and acquisition for tomography by NMR.** Torre Neto, A.; Martins, M.J.; Panepucci, H.C. (Sao Paulo Univ., Sao Carlos, SP (Brazil). Inst. de Fisica e Quimica). 1987. (In Portuguese). NTIS (US Sales Only), PC A09/MF A01. Order Number DE88703566/JAW. (CONF-8705181—).

From 10. national meeting on condensed matter physics; Caxambu, Brazil (5 May 1987).

47354 **(INIS-mf—11280) Testosterone determination in amniotic fluid for sec diagnosis.** Quiron C, M.M. (Departamento de Obstetricia del Hospital Roosevelt (Guatemala)). (Universidad de San Carlos de Guatemala, Guatemala City). Nov 1985. 35p. (In Spanish). NTIS (US Sales Only), PC A03/MF A01. Order Number DE88703902/JAW.

This study was carried on 50 samples of amniotic fluid obtained from pregnant patients with gestation old of 38 to 40 weeks; diagnosis of the foetus sex was made by measuring the testosterone levels by radioimmunoassay technique. It was found that 94% of the cases were correctly diagnosed. The testosterone levels found in the amniotic fluid of male and female foetus were significantly different (L<0.01) these confirm the efficacy of the method.

47355 **(INIS-mf—11281) Dexametazone suppression test (DST) for diagnosing of depression syndrome.** Rejopachi P, L.A. (Hospital Nacional de Salud Mental (Guatemala)). (Universidad de San Carlos de Guatemala, Guatemala City). Sep 1984. 58p. (In Spanish). NTIS (US Sales Only), PC A04/MF A01. Order Number DE88703903/JAW.

The dexametazone suppression test (DST) is a very valuable neuroendocrin assay as auxiliar method for diagnosing the depression. The serum cortisol levels of 20 patients of the Hospital de Salud Mental and of a control group were determined by radio-immunoassay technique. Normal concentration was defined as 5 micrograms per deciliter. Among depressed patients the average value was 9.8865 micro-grams per deciliter; having the test a 85% of positiveness. Among the control group the average value found was 1.167 micro-grams per deciliter, with a 20% of positiveness for the test.

47356 **(INIS-mf—11283) Seric unconjugated Estrial as a prediction in fetal pulmonar maturity.** Velasquez F, A.Y. (Departamento de Gineco-Obstreticia del Hospital General San Juan de Dios (Guatemala)). (Universidad de San Carlos de Guatemala, Guatemala City). Jul 1986. 57p. (In Spanish). NTIS (US Sales Only), PC A04/MF A01. Order Number DE88703904/JAW.

It was determined the effectivity and utility of the measurement of seric unconjugated estriol levels by radioimmunoassay, as a non invasive technique for determinating fetal lung maturity, correlating with Clement's test and optical density of the amniotic liquid. The study was made in 50 pregnant patients between the 37 and 52 weeks of gestation; samples of 5 to 8 cc of blood for the trial were collected. The evaluation of the new born was made by APGAR, gestational age by Ballard method and the presence of idiopatic respiratory difficulties by Silverman.

47357 **(INIS-mf—11286) Monoclonal antibodies and cancer. Studies on the use of monoclonal antibodies for imaging and therapy of cancer, with special emphasis on ovarian carcinoma.** Haisma, H.J. (Rijksuniversiteit Utrecht (Netherlands)). 17 Dec 1987. 198p. NTIS (US Sales Only), PC A09/MF A01. Order Number DE88703906/JAW.

Contains summary in Dutch and previously published material.

The usefulness of radiolabeled monoclonal antibodies for imaging and treatment of human (ovarian) cancer was investigated. A review of tumor imaging with monoclonal antibodies is presented. Special attention is given to factors that influence the localization of the antibodies in tumors, isotope choice and methods of radiolabeling of the monoclonal antibodies. Two monoclonal antibodies, OC125 and OV-TL3, with high specificity for human epithelial ovarian cancer are characterized. A simple radio-iodination technique was developed for clinical application of the monoclonal antibodies. The behavior of monoclonal antibodies in human tumor xenograft systems and in man are described. Imaging of tumors is complicated because of high background levels of radioactivity in other sites than the tumor, especially in the bloodpool. A technique was developed to improve imaging of human tumor xenographs in nude mice, using subtraction of a specific and a non-specific antibody, radiolabeled with /sup 111/In, /sup 67/Ga and /sup 131/I. To investigate the capability of the two monoclonal antibodies, to specifically localize in human ovarian carcinomas, distribution studies in mice bearing human ovarian carcinoma xenografts were performed. One of the antibodies, OC125, was used for distribution studies in ovarian cancer patients. OC125 was used because of availability and approval to use this antibody in patients. The same antibody was used to investigate the usefulness of radioimmunoimaging in ovarian cancer patients. The interaction of injected radiolabeled antibody OC125 with circulating antigen and an assay to measure the antibody response in ovarian cancer patients after injection of the antibody is described. 265 refs.; 30 figs.; 19 tabs.

47358 **(INIS-mf—11288) Pathophysiological aspects of acute hepatic encephalopathy in the rat. An electroencephalographic, biochemical and in vivo brain NMR spectroscopic study.** Deutz, N.E.P. (Amsterdam Univ. (Netherlands)). 10 Mar 1988. 186p. NTIS (US Sales Only), PC A09/MF A01. Order Number DE88703908/JAW.

Contains summary in Dutch.

The aim of the present thesis is to elucidate the pathogenesis of acute hepatic encephalopathy (HE). In order to study acute HE, plasma and brain concentrations were measured of ammonia, aminoacids, lactate and polyamines as well as brain energy rich phosphates. In addition new techniques of brain research were developed and applied. 277 refs.; 29 figs.; 18 tabs.

47359 **(JINR—13-87-702) Simple version of X-ray computerized tomograph for receiving topometric information.** Abazov, V.M.; Andreev, G.A.; Zorin, V.P. (Joint Inst. for Nuclear Research, Dubna (USSR). Lab. of Nuclear Problems). 1987. 9p. (In Russian). NTIS (US Sales Only), PC A02/MF A01. Order Number DE88703666/JAW.

The 128-channel computerized X-ray tomograph operating on-line with HP-21MX computer has been developed for receiving topometric information about inside organs of patient body in a proton beam plane and for subsequent planning of radiation treatment. In the chosen variant of installation X-ray apparatus and detector block are fixed immovably on the walls of a procedure box, and an examined object is rotated with a rotational stand included into the arrangement for proton therapy. The detector system consists of 128 CsI(Tl) scintillation counters working in a combination with FEU-85 photomultipliers. Information from the detctors passes to a special designed logarithmic ADC. The results are displayed on a colour or a half-tone black-white displays. Preliminary tests of the device make it possible to use it for increasing the proton therapy effectiveness. It has been found that the error in determining the total thickness of the substance to a centre of dose maximum localization is no more than 0.5 g/cm/sup 2/. It is significantly less than in the case of the calculation mehod. The irradiation dose is no more than 20 mrad during one diagnostic procedure. 11 refs.; 6 figs.

47360 **(PNL—6534) Health physics manual of good practices for plutonium facilities.** Brackenbush, L.W.; Heid, K.R.; Herrington, W.N.; Kenoyer, J.L.; Munson, L.F.; Munson, L.H.; Selby, J.M.; Soldat, K.L.; Stoetzel, G.A.; Traub, R.J. (Pacific Northwest Lab., Richland, WA (USA)). May 1988. Contract AC06-76RL01830. 251p. NTIS, PC A12/MF A01; 1; GPO Dep. Order Number DE88013607/JAW.

This manual consists of six sections: Properties of Plutonium, Siting of Plutonium Facilities, Facility Design, Radiation Protection, Emergency Preparedness, and Decontamination and Decommissioning. While not the final authority, the manual is an assemblage of information, rules of thumb, regulations, and good practices to assist those who are intimately involved in plutonium operations. An in-depth understanding of the nuclear, physical, chemical, and biological properties of plutonium is important in establishing a viable radiation protection and control program at a plutonium facility. These properties of plutonium provide the basis and perspective necessary for appreciating the quality of control needed in handling and processing the material. Guidance in selecting the location of a new plutonium facility may not be directly useful to most readers. However, it provides a perspective for the development and implementation of the environmental surveillance program and the in-plant controls required to ensure that the facility is and remains a good neighbor. The criteria, guidance, and good practices for the design of a plutonium facility are also applicable to the operation and modification of existing facilities. The design activity provides many opportunities for implementation of features to promote more effective protection and control. The application of "as low as reasonably achievable" (ALARA) principles and optimization analyses are generally most cost-effective during the design phase. 335 refs., 8 figs., 20 tabs.

47361 **(TNO-RD-E—8505-245) Calibration of radiotherapy-apparatus (10-50 kV) by means of TLD ('PCTL').** Julius, H.W.; Stutterheim, H.J.; Busscher, F.A.I. (Gezondheidsorganisatie TNO, Arnhem (Netherlands). Radiologische Dienst). 1985. 32p. (In Dutch). NTIS (US Sales Only), PC A03/MF A01. Order Number DE88703943/JAW.

A method, based on the technique of thermoluminescence dosimetry, to determine both radiation quality and exposure (rate) of narrow X-ray beams between 10 and 50 kV has been developed. For this purpose a small dosimeter has been designed consisting of a perspex cylinder (39 mm in diameter, 15 mm high), in the center of which four stacks of four LiF (TLD-100) detectors each are located. The stacks are separated by thin (1 mm) perspex walls. This design essentially provides four layers of LiF material, each of which, when irradiated at normal incidence, acts as a radiation filter for the layer(s) behind it. From the ratios of the radiation doses measured for each of the consecutive layers the HVL of the radiation beam can be determined. This information, together with calibration using /sup 60/Co gamma radiation, leads to the absolute value of the exposure at the location of the entrance layer and hence to the average exposure rate provided the exposure time is known. Using the dosimeter described above, the exposure can be measured with a precision of about 2.5% (1 s.d.), as can be calculated from the standard deviation of the ratios of the exposures measured with a calibrated ionization chamber and the corresponding exposures determined with the new dosimeter, where the precision of the ionization chamber is assumed to be about 3%. 7 figs.; 8 tabs.

47362 **Radionuclides in therapy.** Friedman, A.M.; Seevers, R.H.; Spencer, R.P. Boca Raton, FL; CRC Press Inc. (1987). 224p. CRC Press Inc., 2000 Corporate Blvd. NW, Boca Raton, FL 33431.

This book presents a survey of uses of parenterally administered radionuclides as therapeutic sources and concentrates on both the basic considerations of each mode of use as well as the clinical results and experiences. This volume provides a source of information for the clinical physician and scientist involved in therapy, and describes current techniques for the scientist involved in developing new methodologies.

5507 Microbiology

REFER ALSO TO CITATION(S) 46234, 47336, 47345, 47351

47363 **(DOE/ER/13197—T2) Methane producing bacteria: Immunological characterization: Progress report, April 1, 1984--June 30, 1988.** Conway de Macario, E.; Macario, A.J.L.; Wolin, M.J. (New York State Dept. of Health, Albany (USA). Center for Labs. and Research). 1988. Contract FG02-84ER13197. 9p. NTIS, PC A02/MF A01; 1; GPO Dep. Order Number DE88012973/JAW.

A major contribution of this research has been a significant advance of the immunology of methanogens and other archaebacteria (e.g., extreme halophiles). The foundations have been laid to begin the immunologic study of microbes which are non-methanogens themselves but are important for the fermentation process. This work helped to make clear that bacterial immunology goes beyond the study of pathogens for man, animals, or plants. Immunology can be applied successfully to the study of isolates of importance to understand evolution, phylogeny, ecology, bio-conversion systems, and to advance methanogenic biotechnology. Immunology holds considerable potential to aid in genetic and genetic engineering manipulations as well as in in situ handling of microbes relevant to methanogenesis. Thus, antibodies can help in the discovery of useful microbes, the generation of improved stains, the selection of desirable microorganisms, and in the monitoring and controlling of bioreactors. Immunogolic work in this new field should generate knowledge and devices relevant to areas such as Biological Energy Research, Ecology of Microorganisms, and Environmental (Sanitary) Engineering. In this regard, this work has contributed a comprehensive antiserum bank, a large panel of calibrated polyclonal antibody probes, and techniques for producing and utilizing these probes in the study of methanogens and related bacteria. 67 refs.

47364 **(DOE/ER/60477—T1) Distribution, abundance, and activities of microorganisms in deep subsurface strata: Progress report for work up through January 1988.** Ghiorse, W.C. (Cornell Univ., Ithaca, NY (USA). Dept. of Microbiology). May 1988. Contract FG02-86ER60477. 3p. NTIS, PC A02/MF A01; 1; GPO Dep. Order Number DE88013074/JAW.

The overall research goals of this project, outlined in (DOE/ER-0278), are: (1) Determine presence, abundance, diversity of microflora in deep subsurface sediments; (2) Determine environmental factors controlling microbial activity in deep sediments; (3) Determine metabolic capabilities and function of deep subsurface microorganisms; (4) Compare deep subsurface microflora with surface and near surface microflora; (5) Evaluate the potential of deep sediments for biodegradation and microbial remediation of environmental contamination. During the past year, our activities have focused primarily on the first four goals as detailed in this report. We

have also conducted basic research on long-term survival of aquifer bacteria.

47365 (DP-MS—88-5) What do fecal coliforms indicate in tropical waters?. Hazen, T.C. (Savannah River Lab., Aiken, SC (USA)). 1988. Contract AC09-76SR00001. 30p. (CONF-880830—1). NTIS, PC A03/MF A01; GPO Dep. Order Number DE88006507/JAW.

From 1. biennial symposium of water quality; Alberta, Canada (29 Aug 1988).

High densities of total and fecal coliform bacteria have been detected in pristine streams and in ground water samples collected from many tropical parts of the world, even in epiphytic vegetation 10 m above ground in the rain forest of Puerto Rico. Nucleic acid (DNA) analyses of Escherichia coli from pristine tropical environs has indicated that they are identical to clinical isolates of E. coli. Many tropical source waters have been shown to have enteric pathogens in the complete absence of coliforms. Diffusion chamber studies with E. coli at several tropical sites reveal that this bacterium can survive indefinitely in most freshwaters in Puerto Rico. An evaluation of methods for the enumeration of fecal coliforms showed that currently used media have poor reliability as a result of large numbers of false positive and false negative results when applied to tropical water samples. Total and fecal coliform bacteria are not reliable indicators of recent biological contamination of waters in tropical areas. Fecal streptococci and coliphages in tropical waters, violate the same under lying assumptions of indicator assays as the coliforms. Anaerobic bacteria like Bifidobacterium spp. and Clostridium perfringens show some promise in terms of survival but not in ease of enumeration and media specificity. The best course at present lies in using current techniques for direct enumeration of pathogens by fluorescent staining and nucleic acid analysis and developing tropical maximum containmant levels for certain resistant pathogens in tropical waters. 66 refs.

5509 Pathology

47366 (PB—88-195805/XAB) Toxicology Information Program (TIP) Files Demo Disk (for microcomputers). Software. Perkins, M. (National Library of Medicine, Bethesda, MD (USA). Specialized Information Services). 9 May 1988. vp. NTIS CP D99.

Supersedes PB—87-143327; The software is contained on 5 1/4-inch diskette, double sided, double density compatible with the IBM PC, AT, ST, PS/2 microcomputer. Diskettes are in ASCII format.

The Toxicology Information Program (TIP) Files Demo Disk is an interactive, microcomputer demonstration of the CHEMLINE, TOXLINE, TOXLIT, RTECS, HSDB, CCRIS, and DIRLINE files. It is designed to acquaint new users with the content and search capabilities of these data bases. There is a section on each data base containing a brief description of the file and several sample searches. The program is written in PILOTplus authoring language for implementation on IBM-PC, PC-XT, PC-AT,PS/2 and fully compatible computers, using DOS2.0 or higher operating system. It requires 256K RAM memory and one disk drive. It supports most monochrome, color-graphics, and enhanced color graphics displays.

5510 Physiological Systems

REFER ALSO TO CITATION(S) 46728

5520 Public Health

REFER ALSO TO CITATION(S) 47336, 47342, 47365

5530 Agriculture And Food Technology

47367 (IAEA-R—3074-F) Nitrogen fixation by forage legumes grown in pure stands and in mixtures with cereals. Final report for the period February 1982 - November 1987. Papastylianou, I. (Agricultural Research Inst., Nicosia (Cyprus)). (International Atomic Energy Agency, Vienna (Austria)). Mar 1988. 4p. NTIS (US Sales Only), PC A02/MF A01. Order Number DE88703824/JAW.

Nitrogen fertilizers labelled with /sup 15/N were used to estimate N/sub 2/ fixed in Vetch (Vicia sativa), Peas (Pisum sativum), Chickpeas (Cicer arietinum), medic (Medicago truncatula), ochrus vetch (Lathyrus ochrus), bitter vetch (Vicia ervilia), tick bean (Vicia faba), woolly pod vetch (Vicia dacycarpa), and faba bean (Vicia faba) in Cyprus between 1982 and 1987. The proportions of N derived from N/sub 2/ fixation were as follows: Vetch, 70-80%; peas, 30-70%; medic, 50-70%; ochrus vetch, 47-79%; bitter vetch, 33-70%; faba bean, 49-80%; tick bean, 84% (for only one year); woolly pod vetch, 79% (for one year) and chickpea, 41% (for one year). Large seasonal variations in N/sub 2/ fixation were noticed, and high inorganic N was found to depress N/sub 2/ fixation. Both the A-value and /sup 15/N isotope dilution approaches gave statistically similar estimates of N/sub 2/ fixed. Cereals grown in mixture with legumes contained lower /sup 15/N enrichments than the pure cereal crop, which might indicate the transfer of fixed N/sub 2/ from the legume to the associated cereal. However, the N uptake profiles of the sole versus mixed cereal crops were often dissimilar. It is therefore uncertain if the discrepancy in /sup 15/N enrichments is largely attributable to N transfer or to the mismatched N uptake at different periods. Preliminary data from studies in which /sup 15/N-labelled plant tissues were incorporated into soil as a source of a relatively low-fluctuating /sup 15/N//sup 14/N ratio in soil indicated that this may be a more reliable approach for studying N transfer between plants, since differences in N uptake patterns in the different cropping systems is of reduced effect in the final results.

47368 (INIS-mf—11086/87(no.2)) Activities of the Entomology Unit. Report No.2, 1987. (International Atomic Energy Agency, Vienna (Austria); Food and Agriculture Organization of the United Nations, Rome (Italy)). 1987. 76p. NTIS (US Sales Only), PC A05/MF A01. Order Number DE88703900/JAW.

This semi-annual report describes the activities of the Entomology Unit at the Agency's Laboratories, Seibersdorf, between 1 July and 31 December 1987. Tsetse nutrition research have been carried out. Emphasis was put on attempts to improve the nutritional quality of whole blood diets by simple physical treatments. Other studies included chemical analyses of tsetse tissue and diets, investigations of the effect of fly nutrition on endosymbionts, and attempts to determine the importance of haem in haemoglobin digestion. Different yeasts for use in medfly mass rearing were compared. The results of the radiosensitivity of eggs and larva of Ceratitis capitata indicated that mature eggs were more tolerant than immature eggs and that mature larva were more tolerant than immature larva to irradiation. Figs and tabs.

47369 (INIS-mf—11715) Bundesforschungsanstalt fuer Ernaehrung (BFE), Karlsruhe - annual report 1986. (Bundesforschungsanstalt fuer Ernaehrung, Karlsruhe (Germany, F.R.)). 1987. 57p. (In German). NTIS (US Sales Only), PC A04/MF A01. Order Number DE88754590/JAW.

Part A of the annual report 1986: 'Research activities sponsored by the Federal Minister of Food, Agriculture and Forestry'.

The annual report of the BFE informs about the tasks of the institution, the organisational structure, and the actual staff. The scientific activities of the various institutes and the research results achieved are reported in brief, together with activities within the

framework of international cooperation agreements. A list of publications issued in 1986 is added. The BFE's activities currently concentrate on the following research subjects: Storage, shipping, processing, and quality of food. Fertilizing and food quality. Sensory, toxicologic, nutritional and economic evaluation of food. Food characterization by means of objective methods. Important components, foreign matter, and radionuclides in food. Development of analytic methods for food research. Hygenic improvement of food. Evaluation of catering systems of importance to communal provisions. Nutritional requirements and behaviour of the population. Quality and cost of food. Information of the consumer about wholesome food and nutrition. Documentation and information activities.

56 BIOMEDICAL SCIENCES, APPLIED STUDIES

5601 Radiation Effects

REFER ALSO TO CITATION(S) 47344

47370 **(CEGB-TPRD/B—0933/R87) Revised estimates of the radiological impact of the transport of irradiated nuclear fuels within the UK.** Macdonald, H.F. (Central Electricity Generating Board, Berkeley (UK). Berkeley Nuclear Labs.). Oct 1987. 17p. NTIS (US Sales Only), PC A03/MF A01. Order Number DE88754264/JAW.

This report presents revised estimates of individual and collective doses associated with irradiated fuel movements from CEGB and SSEB nuclear power stations within the UK. In particular, earlier estimates of transport doses have been updated to take account of recent changes in the patterns of rail traffic. This results in a reduction in the estimated maximum individual doses to members of the public living near marshalling yards where flasks stop en route and also to rail workers incidentally exposed at these locations. The maximum levels of individual dose associated with irradiated fuel transport within the UK are in general low compared with those due to natural background radiation. Further, the associated collective doses are small compared with other sources of dose arising in the nuclear fuel cycle and represent < 10/sup -4/ % of the natural background radiation dose to the UK population. In absolute terms the maximum contributions to the annual transport collective doses from Magnox, AGR and projected PWR fuel movements are estimated to be 18, 9 and 0.7 man mSv center dot a/sup -1/ respectively. These results neglect any reduction in doses due to the effects of shielding by buildings or natural obstacles such as railway cuttings or tunnels. Inclusion of these effects has been estimated to reduce the annual transport collective doses to 13, 6 and 0.45 man mSv center dot a/sup -1/ for Magnox, AGR and PWR fuels respectively. (U.K.).

47371 **(CONF-880729—1) Environmental radiation standards.** Kocher, D.C. (Oak Ridge National Lab., TN (USA)). 1988. Contract AC05-84OR21400. 79p. NTIS, PC A05/MF A01; 1; GPO Dep. Order Number DE88012925/JAW.

From 33. annual meeting of the Health Physics Society; Boston, MA, USA (4 Jul 1988).

The document describes a presentation which reviewed current and proposed radiation standards, recommendations, and guidelines for limiting radiation exposures of the public. The document reviews the regulatory framework for limiting routine releases of radioactivity to the environment and the resulting public exposures, and contains estimates of risk corresponding to standards, recommendations and guidances.

47372 **(CONF-8804141—3) Calculated yields of ammonia in the radiolysis of deoxygenated solutions of glycylglycine.** Bolch, W.E.; Turner, J.E.; Yoshida, H.; Jacobson, K.B. (Florida Univ., Gainesville (USA). Dept. of Environmental Engineering Sciences; Oak Ridge National Lab., TN (USA)). 1988. Contract AC05-84OR21400. 16p. NTIS, PC A03/MF A01; 1; GPO Dep. Order Number DE88012482/JAW.

From 11. Werner Brandt workshop on penetration phenomena of charged particles in water; Oak Ridge, TN, USA (14 Apr 1988).

This paper presents detailed Monte Carlo simulations of physical and chemical interactions occurring within electron tracks in deoxygenated solutions of glycylglycine. Hydrated electrons produced within these tracks react with the solute to produce ammonia and a peptide secondary free radical. Calculated yields of ammonia are presented for a range of solute concentrations and electron energies. Excellent agreement is found between calculated and measured yields of ammonia in solutions irradiated by 250-kVp x-rays and ^{60}Co gamma rays. 12 refs., 5 figs.

47373 **(DOE/ER/60409—3-Vol.1) Immunodeficiency syndromes: Disorder of lymphocytopoiesis caused by environmental agents: Volume 1, comprehensive progress report.** Rosse, C. (Washington Univ., Seattle (USA). Dept. of Biological Structure). [1988]. Contract FG06-86ER60409. 66p. NTIS, PC A04/MF A01; 1; GPO Dep. Order Number DE88012949/JAW.

The studies we have performed have provided a substantial database that supports these beliefs. Our work sponsored by DOE has defined experimental tumor systems in which we have known that there is interaction between the bone marrow and certain neoplasms. We have documents that these interactions are important in host responses against tumors, and that certain tumors profoundly alter the production of several types of cells in the lymphopoiesis in an experimental model of graft-vs-host disease (GVHD) that develops as a consequence of bone marrow transplantation between H-2 identical mouse strains that differ in monorhistocompatibility antigens (minor HA). Parallel with the experimental systems that investigated interactions between the bone marrow and tumors, we have maintained an active program concerned with fundamental studies of lymphocyte production and differentation in the bone marrow, thymus, and periphery. The elucidation of the mechanisms that regulate the differentiation program of T, B, and natural killer (NK) cells remains a requisite for understanding at what level carcinogenic and noncarcinogenic environmental factors exert their influence on the lymphomyeloid complex. We have made notable progress with studies concerning the regulation of B lymphocyte production, the maintenance of T cell precursors in the bone marrow and thymus and the cell traffic between these organs, and especially in unravelling the lineage relationship, turnover, and functional heterogeneity of NK cells. 173 refs., 11 figs., 14 tabs.

47374 **(DOE/ER/60417—T2) Fast neutron dosimetry: Progress summary.** DeLuca, P.M. Jr. (Wisconsin Univ., Madison (USA). Dept. of Medical Physics). 1988. Contract FG02-86ER60417. 59p. NTIS, PC A04/MF A01; 1; GPO Dep. Order Number DE88013123/JAW.

The purpose was to investigate the radiological physics and biology of very low energy photons derived from a 1-GeV electron synchrotron storage ring. An extensive beam line and irradiation apparatus was designed, developed, and constructed. Dosimetry measurements required invention and testing of a miniature absolute calorimeter and a cell irradiation fixture suitable for scanning exposures under computer control. Measurements of the kerma factors of oxygen, aluminum and silicon for 14-20 MeV neutrons. Custom designed miniature proportional counters of cylindrical symmetry were employed in these determinations. The oxygen kerma factor was found significantly lower than values calculated from microscopic cross sections. We also tested Mg and Fe walled conventional spherical counters. The direct neutron-counting gas interaction is significant enough for these counters that a correction is needed. We also investigated the application of Nuclear Magnetic Resonance spectroscopy to radiation dosimetry. Our purpose was to take advantage of recent development of very high-field magnets, complex RF-pulse techniques for solvent suppression, and improved spectral analysis techniques.

47375 **(ENEA-RT-PAS—87-15) The coal-fired power plant of Vado Ligure: study on radiological consequences from radioactive effluents into the environment. Progress report No. 4.** Ferrara, V. (ENEA, Rome (Italy)). Dec 1987. 115p. (In Italian). NTIS (US Sales Only), PC A06/MF A01. Order Number DE88754230/JAW.

The problem of radiological impact from radioactive effluents, released by the planned new coal-fired power plant of Vado Ligure, is examined. Using health-physics methods of evaluation, the highest levels of dose equivalents to the population are computed. Taking into account possible errors due to the conservative models adopted, it is concluded that the induced radiological risks are to be considered negligible, both referring to the actual natural radiological levels in the environment, and considering the maximum permissible levels stated in international recommendations.

47376 **(GSF—2/87) Experimental determination of the transfer functions feed/beaf, feed/pork, feed/milk for Cs-137, Co-60, Mu-54, Na-22, I-131, and Tc-95m.** Voigt, G.; Henrichs, K.; Proehl, G.; Paretzke, H.G. (Gesellschaft fuer Strahlen- und Umweltforschung m.b.H. Muenchen, Neuherberg (Germany, F.R.). Inst. fuer Strahlenschutz). May 1986. 68p. (In German). NTIS (US Sales Only), PC A04/MF A01. Order Number DE88754587/JAW.

After the Chernobyl reactor accident, experimental studies have been made with a group of animals, and the results measured are presented in tabular form. The transfer factors of Na-22 have been found to be affected by the daily amount of stable sodium content in the feed. Mn-54 quantities in the feed have been too low to be measured. For two different feeding modes, equilibrium transfer factors of Co and Cs have been determined in pork. As to cereals and potatoe diets, upper limits of transfer have been found. The data obtained for the transfer factor of iodine to milk are in good agreement with published data.

47377 **(IAEA-R—3173-F) Radiation cytogenetic in vitro studies on human donors in the development of a suitable biological dosimeter. Final report for the period 1 July 1982 - 31 December 1987.** Barjaktarovic, N. (Clinical Hospital Centre Zvezdara, Belgrade (Yugoslavia)). (International Atomic Energy Agency, Vienna (Austria)). Feb 1988. 6p. NTIS (US Sales Only), PC A02/MF A01. Order Number DE88703825/JAW.

The final report is on the work carried out under the Agency research contract 3173/RB entitled "Radiation cytogenetic in vitro studies on human donors in the development of a suitable biological dosimeter", at the Clinical Hospital Centre "Zvezdara" in Belgrade, Yugoslavia. In co-operation and co-ordination dissemination with an international team of cytogeneticists under the IAEA CRP, the development of a suitable biological dosimetry system has been accomplished at the national institute to assist reliably in the absorbed radiation-dose assessment of accidentally-over-exposed personnel. The quantitative yield of asymmetrical chromosomal aberrations, such as dicentrics, rings and fragments consequent to exposure(s) to radiation overdose, help in such estimation of vital prognostic and radiation protection significance. This biological dosimeter system is particularly essential where the exposed person was not wearing any physical dosemeter during the accident. Prerequisite for implementation of an effective biological dosimetry is the availability of a reliable standard dose-response curve and an adherence to a protocol for lymphocytic chromosome analysis in first division phase of lymphocytes. The validation of the reported biological dosimeter is established through its successful analysis of a simulated over-exposure incident, with the associated error of less than 10%. Analytical cytogenetic methods for whole- and part-body acute exposures have been discussed. Part of the results have been reported in the publications under the CRP concerned.

47378 **(INIS-BR—1164, pp 20) Study of laser radiation effects on living tissue.** Cotta, M.A.; Nicola, J.H. (Universidade Estadual de Campinas (Brazil). Inst. de Fisica). 1987. (In Portuguese). NTIS (US Sales Only), PC A09/MF A01. Order Number DE88703566/JAW. (CONF-8705181—).

From 10. national meeting on condensed matter physics; Caxambu, Brazil (5 May 1987).

47379 **(INIS-BR—1194) Measurements of cesium-137 internal decontamination.** Farina, R. (Comissao Nacional de Energia Nuclear de Brasil, Rio de Janeiro). 1988. 10p. (In Portuguese). NTIS (US Sales Only), PC A02/MF A01. Order Number DE88703887/JAW.

In the accident with Cs 137 which took place in Goiania, it could be verified that the majority of the victims presented internal and external contamination. In order to minimize deposits in internal organs and tissues and to enhance the excretion of Cs 137 we started treating the patients with: (1) Prussian Blue, oral administration, in about 46 patients, (2) Diuretics, oral administration, in 17 patients, and (3) Increasing the Cs 137 elimination by the sweat. Those proceedings were done under rigourous clinical evaluation and with data from radiochemical assay of excreta and afterwards with data obtained through the "in vivo" analysis though Whole Body Counting (Body Burden).

47380 **(INIS-BR—1199) Evaluation and treatment of the local radiation burns caused by the Goiania radiation accident.** Oliveira, A.R. de. (NUCLEBRAS, Rio de Janeiro (Brazil)). 1988. 1p. NTIS (US Sales Only), PC A02/MF A01. Order Number DE88703891/JAW.

47381 **(LBL—25110) Annual environmental monitoring report of the Lawrence Berkeley Laboratory.** Schleimer, G.E. (ed.). (Lawrence Berkeley Lab., CA (USA)). 1987. Contract AC03-76SF00098. 39p. NTIS, PC A03/MF A01; 1; GPO Dep. Order Number DE88014047/JAW.

The Enviroomental Monitoring Program of the Lawrence Berkeley Laboratory is described. Data for 1987 are presented and general trends are disussed. 15 refs., 7 figs., 21 tabs.

47382 **(NVO—232-Rev.4) Radiation safety manual for the Nevada Test Site.** (Reynolds Electrical and Engineering Co., Inc., Las Vegas, NV (USA); USDOE Nevada Operations Office, Las Vegas). May 1988. Contract AC08-84NV10327. 237p. NTIS, PC A11/MF A01; 1; GPO Dep. Order Number DE88013578/JAW.

The Radiation Safety Manual for the Nevada Test Site, NVO-232, defines minimum radiation protection standards for test site personnel and DOE/NV contractor personnel off-site. It establishes, under Department of Energy policy, responsibilities for radiological protection standards, personnel dosimetry and monitoring, area control, protective equipment and safety requirements, radioactive material control, transfer and shipment, citing requirements and codes, and standards of pertinent federal agencies. 15 refs., 3 tabs.

47383 **(PNL—6500-Pt.1) Pacific Northwest Laboratory annual report for 1987 to the DOE Office of Energy Research: Part 1, Biomedical Sciences.** Park, J.F. (Pacific Northwest Lab., Richland, WA (USA)). Feb 1988. Contract AC06-76RL01830. 124p. NTIS, PC A07/MF A01; 1; GPO Dep. Order Number DE88011885/JAW.

This report summarizes progress on OHER biomedical and health-effects research conducted at Pacific Northwest Laboratory in FY 1987. The research develops the knowledge and scientific principles necessary to identify, understand, and anticipate the long-term health consequences of energy-related radiation and chemicals. Our continuing emphasis is to decrease the uncertainty of health-effects risk estimates from existing and/or developing energy-related technologies through an increased understanding of how radiation and chemicals cause health effects. The report is arranged to reflect PNL research relative to OHER programmatic structure. The first section, on human health effects, concerns statistical and epidemiological studies for assessing health risks. The next section, which contains reports of health-effects research in biological systems, includes research with radiation and chemicals. The last section is related to medical applications of nuclear technology.

47384 **(PNL—6620-Vol.2) Personnel neutron dose assessment upgrade: Volume 2, Field neutron spectrometer for health physics applications.** Brackenbush, L.W.; Reece, W.D.; Miller, S.D.; Endres, G.W.R.; Durham, J.S.; Scherpelz, R.I.; Tomeraasen, P.L.; Stroud, C.M.; Faust, L.G.; Vallario, E.J. (Pacific Northwest Lab., Richland, WA (USA)). Jul 1988. Contract AC06-76RL01830. 61p. NTIS, PC A07/MF A01; 1; GPO Dep. Order Number DE88014095/JAW.

Both the (ICRP) and the (NCPR) have recommended an increase in neutron quality factors and the adoption of effective dose equivalent methods. The series of reports entitled Personnel Neutron Dose Assessment Upgrade (PNL-6620) addresses these changes. Volume 1 in this series of reports (Personnel Neutron Dosimetry Assessment) provided guidance on the characteristics, use, and calibration of personnel neutron dosimeters in order to meet the new recommendations. This report, Volume 2: Field Neutron Spectrometer for Health Physics Applications describes the development of a portable field spectrometer which can be set up for use in a few minutes by a single person. The field spectrometer described herein represents a significant advance in improving the accuracy of neutron dose assessment. It permits an immediate analysis of the energy spectral distribution associated with the radiation from which neutron quality factor can be determined. It is now possible to depart from the use of maximum Q by determining and realistically applying a lower Q based on spectral data. The field spectrometer is made up of two modules: a detector module with built-in electronics and an analysis module with a IBM PC{reg sign}-compatible computer to control the data acquisition and analysis of data in the field. The unit is simple enough to allow the operator to perform spectral measurements with minimal training. The instrument is intended for use in steady-state radiation fields with neutrons energies covering the fission spectrum range. The prototype field spectrometer has been field tested in plutonium processing facilities, and has been proven to operate satisfactorily. The prototype field spectrometer uses a ^{3}He proportional counter to measure the neutron energy spectrum between 50 keV and 5 MeV and a tissue equivalent proportional counter (TEPC) to measure absorbed neutron dose.

47385 **(PNL-SA—14255) The effects of errors in the measurement of continuous exposure variables on the assessment of risks.** Gilbert, E.S. (Pacific Northwest Lab., Richland, WA (USA)). Jul 1986. Contract AC06-76RL01830. 42p. NTIS, PC A03/MF A01; 1; GPO Dep. Order Number DE88013115/JAW.

Exposure variables in epidemiological studies are seldom measured without error. However, it is unusual for such error to be taken into account in analyzing data, and thus distortion of results may occur. These distorting effects are evaluated for the fitting of linear and log-linear proportional hazards models based on single continuous exposure variable, and are quantified under several sets of assumptions regarding the conditional distributions of the measured exposures given the true exposures, as well as assumptions regarding the true exposure distributions. For a wide range of assumptions, it is found that the most serious consequence of ignoring error is downward bias in the estimation of regression coefficients. In addition, the shape of the dose-response function may be distorted, and variances of estimated parameters may be underestimated. Except for the case of very large errors combined with highly skewed exposure distributions, tests of the null hypothesis of no effect that ignore error are found to be nearly as powerful as an optimal test, available if the error structure is known. 19 refs.

47386 **(PNL-SA—15412) Medical and health physics management of a plutonium wound.** Carbaugh, E.H.; Decker, W.A.; Swint, M.J. (Pacific Northwest Lab., Richland, WA (USA); Westinghouse Hanford Co., Richland, WA (USA); Hanford Environmental Health Foundation, Richland, WA (USA)). Apr 1988. Contract AC06-76RL01830. 16p. (CONF-880514—3). NTIS, PC A03/MF A01; 1; GPO Dep. Order Number DE88012690/JAW.

From Workshop on biological assessment of occupational exposure to actinides; Versailles, France (30 May 1988).

A puncture wound contaminated with plutonium and americium has provided an excellent case study for dealing with internal contamination. This case provides an opportunity to examine the effectiveness of diagnostic techniques, therapeutic techniques, dose assessment practices, and case management philosophy. The wound deposited 48 kBq of transuranic alpha activity in the right index finger. Minor surgery reduced the long-term wound burden to about 5.4 kBq. Chelation therapy with DTPA lasted 17 months and resulted in urinary excretion of about 7 kBq of the deposited activity. Therapy appears to have been effective in limiting early uptake and internal doses from this wound. However, the possibility of slow future uptake from the wound exists. Thus, estimating long-term uptake and dose is difficult. In vivo measurements indicate that residual wound contamination is essentially constant. Within three weeks of the injury, an initial measurable liver burden was reduced by chelation therapy to below detectable limits, and no subsequent build-up has been observed. However, there is indication of a gradually increasing skeleton burden. The axillary lymph nodes have shown relatively constant, detectable activity. 8 refs., 3 figs.

47387 **(PNL-SA—15498) Risk estimates for lung tumors from inhaled $^{239}PuO_2$, $^{238}PuO_2$, and /sup 239Pu/$(NO_3)_4$ in beagle dogs.** Dagle, G.E.; Park, J.F.; Gilbert, E.S.; Weller, R.E. (Pacific Northwest Lab., Richland, WA (USA)). Jun 1988. Contract AC06-76RL01830. 14p. (CONF-880514—2). NTIS, PC A03/MF A01; 1; GPO Dep. Order Number DE88012691/JAW.

From Workshop on biological assessment of occupational exposure to actinides; Versailles, France (30 May 1988).

Lung-cancer risks are being studied in beagle dogs given single exposures to aerosols of $^{239}PuO_2$, $^{238}PuO_2$, or $^{239}Pu(NO_3)_4$. A major objective of these studies is to examine the risk of lung cancer relative to the specific activity of the radionuclide, rate of dose accumulation due to differences in solubilities of the radionuclides, and the presence of competing risk from extrapulmonary lesions. Dose-response relationships were studied for the three groups of dogs, with analyses specifically designed to evaluate differences in response. Based on estimated cumulative dose to the lung, risks were found to differ significantly among the radionuclides; they were highest for $^{239}Pu(NO_3)_4$ and lowest for $^{238}PuO_2$. A model in which the risk was assumed to be a pure quadratic function of dose fit the data much better than a pure linear model. Currently, all three groups of dogs can be compared only to 10 years after exposure. However, it is apparent that the average cumulative dose to the lung may not be an adequate predictor of lung-cancer risk for different isotopic and physicochemical forms of plutonium. 13 refs., 2 tabs.

47388 **(PNL-SA—15829) Practical considerations in the development and application of reference levels.** Selby, J. M.; Kennedy, W. E. Jr.; Swinth, K. L.; Gilbert, R. O.; Soldat, J. K. (Pacific Northwest Lab., Richland, WA (USA)). May 1988. Contract AC06-76RL01830. 11p. (CONF-8806116—2). NTIS, PC A03/MF A01; 1; GPO Dep. Order Number DE88014748/JAW.

From French bilateral symposium on accident exercises and experiences; Tours, France (20 Jun 1988).

Radiological exposures to the public during an accident that releases radioactive materials to the environment occur initially through the air pathway, secondly through a water pathway, and finally, through the food chain. From these exposure pathways, reference levels of radionuclides must be applied to limit public radiation doses. Such reference levels are difficult to develop and apply, particularly if the contaminants are transuranic elements such as plutonium. The reference level must be related to a resultant theoretical dose to the public through generic calculations. However, to permit rapid decisions after an accident, the reference levels need to be related to conditions or media in the environment that can be directly measured. They must also be tied to specific countermeasures such as sheltering, evacuation, or interdiction of drinking water or food supplies. This paper discusses the practical considerations in the development and application of reference levels for transuranic in the environment and the present capability to rapidly detect and quantify their concentrations following accidental contamination events. 16 refs., 3 tabs.

47389 **Central nervous system radiation syndrome in mice from preferential 10B(n, alpha)7Li irradiation of brain vasculature.** Slatkin, D.N.; Stoner, R.D.; Rosander, K.M.; Kalef-Ezra, J.A.; Laissue, J.A. (Brookhaven National Lab., Upton, NY (USA)). *Proceedings of the National Academy of Sciences of the United States of America;* **85**: No. 11, 4020-4024(Jun 1988).

Ionizing radiations were directed at the heads of anesthetized mice in doses that evoked the acute central nervous system (CNS) radiation syndrome. Irradiations were done using either a predominantly thermal neutron field at a nuclear reactor after intraperitoneal injection of 10B-enriched boric acid or 250-kilovolt-peak x-rays

with and without previous intraperitoneal injection of equivalent unenriched boric acid. Since 10B concentrations were approximately equal to 3-fold higher in blood than in cerebral parenchyma during the reactor irradiations, more radiation from alpha and 7Li particles was absorbed by brain endothelial cells than by brain parenchymal cells. Comparison of the LD50 dose for CNS radiation lethality from the reactor experiments with the LD50 dose from the x-ray experiments gives results compatible with morphologic evidence that endothelial cell damage is a major determinant of acute lethality from the CNS radiation syndrome. It was also observed that boric acid is a low linear energy transfer radiation-enhancement agent in vivo.

47300 **Extrapolation of the relative risk of radiogenic neoplasms across mouse strains and to man.** Storer, J.B.; Mitchell, T.J.; Fry, R.J. (Oak Ridge National Lab., TN (USA)). *Radiation Research;* 114: No. 2, 331-353(May 1988).

We have examined two interrelated questions: is the susceptibility for radiogenic cancer related to the natural incidence, and are the responses of cancer induction by radiation described better by an absolute or a relative risk model. Also, we have examined whether it is possible to extrapolate relative risk estimates across species, from mice to humans. The answers to these questions were obtained from determinations of risk estimates for nine neoplasms in female and male C3Hf/Bd and C57BL/6 Bd mice and from data obtained from previous experiments with female BALB/c Bd and RFM mice. The mice were exposed to ^{137}Cs gamma rays at 0.4 Gy/min to doses of 0, 0.5, 1.0, or 2.0 Gy. When tumors that were considered the cause of death were examined, both the control and induced mortality rates for the various tumors varied considerably among sexes and strains. The results suggest that in general susceptibility is determined by the control incidence. The relative risk model was significantly superior in five of the tumor types: lung, breast, liver, ovary, and adrenal. Both models appeared to fit myeloid leukemia and Harderian gland tumors, and neither provided good fits for thymic lymphoma and reticulum cell sarcoma. When risk estimates of radiation-induced tumors in humans and mice were compared, it was found that the relative risk estimates for lung, breast, and leukemia were not significantly different between humans and mice. In the case of liver tumors, mice had a higher risk than humans. These results indicate that the relative risk model is the appropriate approach for risk estimation for a number of tumors. The apparent concordance of relative risk estimates between humans and mice for the small number of cancers examined encourages us to undertake further studies.

47301 **Correlates of long-term alkaline earth retention.** Stebbings, J.H.; Schlenker, R.A.; Keane, A.T.; Kotek, T.J.; Jansen, A.J. (Argonne National Lab., IL (USA)). pp 54-63 of Trace substances in environmental health-XXI. Hemphill, D.D. (ed.). Columbia, MO; University of Missouri (1987). (CONF-8705217—). Contract W-31-109-ENG-38.

From 21. annual conference on trace substances in environmental health; St. Louis, MO, USA (25 May 1987).

Data on 63 subjects from several occupational cohorts, plus iatrogenic subjects, were analyzed to determine effects of sex, age at exposure, exposure duration, and age at measurement upon the coefficient of elimination (λ, % y^{-1}). While 12 women exposed at age 17-18 had λ's significantly lower than those exposed at ages 15-16 or 21-26, λ showed no overall trend with age at exposure among females. Higher radium burdens associated with bone damage are associated with decreased λ's, but neither exposure duration nor age at measurement correlated significantly with λ. The 12 males had λ's about 60% of those for females after adjustment for retention time. The males λ's were lower the earlier the age at exposure. Effects of personal habits were studied in a homogeneous cohort of female Illinois dial painters with relatively uniform ages at first employment. The most powerful predictor of radium loss was the number of cups of coffee and tea consumed per day. Coffee/tea consumption explained ~ 35% of the variance in λ, the effect persisting after deletion of smokers and subjects with x-ray evidence of bone damage. Higher weight/height ratios were associated with higher λ's. Individuals smoking throughout the measurement period had significantly low λ's. A complex interaction of weight/height ratios to both smoking and radium-induced bone damage was observed.

47302 **Radioactivity in persons exposed to fallout from the Chernobyl reactor accident.** Schlenker, R.A.; Oltman, B.G.; Lucas, H.F. (Argonne National Lab., IL (USA)). pp 213-218 of Trace substances in environmental health-XXI. Hemphill, D.D. (ed.). Columbia, MO; University of Missouri (1987). (CONF-8705217—). Contract W-31-109-ENG-38.

From 21. annual conference on trace substances in environmental health; St. Louis, MO, USA (25 May 1987).

Measurements of fallout radioactivity were made in the thyroid region, abdomen, whole body, or urine of 96 persons who were in eastern Europe at the time of the Chernobyl reactor accident or who went there shortly afterward. The most frequently encountered radionuclides were ^{131}I, /sup 134,137/Cs, and $^{106}Ru/^{106}Rh$. The median ^{131}I activity in the thyroids of 42 subjects in whom radioiodine was detected and who were in Europe when the accident began was projected as 42 nCi the day the accident began. The median total body activity of ^{134}Cs in 40 subjects in which it was detected was 1.7 nCi upon arrival in the US. For 51 subjects with detectable ^{137}Cs burdens, the total body activity was 4.6 nCi. The risk of fatal thyroid cancer is less than 3×10^{-6} for nearly all subjects in this series. The risk of fatal cancer from /sup 134,137/Cs for subjects with cesium exposures similar to the ones observed by the authors, but who remained in Europe, is estimated as 1.4×10^{-6} to 4.2×10^{-5} with 95% of the risk attributable to ^{137}Cs.

47303 **Radioactive iodine and cesium in Bavarian citizens after the nuclear reactor accident in Chernobyl.** Kollmer, B.D.; Kriegel, W.E.; Henrichs, K. (Institute fuer Strahlenschutz, Neuherberg (Germany, F.R.)). pp 219-225 of Trace substances in environmental health-XXI. Hemphill, D.D. (ed.). Columbia, MO; University of Missouri (1987). (CONF-8705217—).

From 21. annual conference on trace substances in environmental health; St. Louis, MO, USA (25 May 1987).

In order to evaluate the radiation risk and to improve the procedure of prognostic estimations of a follow-up study of whole body radioactivity in human beings living in Munich or in an area within 100 km distance from it was initiated after the accident. A total of about 200 persons were examined. After the accident some of them changed their normal diet to avoid excessive intake of radioactivity, some continued their normal way of nutrition. Within 4 weeks following the accident special attention was paid to the measurement of ^{131}I. One week after the accident the mean total body content of ^{131}I was about 300 Bq. Subsequently it decreased with a halftime of 9.2 days. The total body content of ^{137}Cs and ^{134}Cs began to increase significantly 4 weeks after the accident. 14 weeks after the accident a plateau was reached at a level of 14 Bq ^{137}Cs and 7 Bq ^{134}Cs per kg body weight. This plateau was kept until 30 weeks after the accident. A second increase of the Cs radioactivity was observed in January 1987 due to the increasing radioactivity in milk and meat. This is a result of the use of contaminated hay harvested within the period right after the accident as winter feed for cattle. The dose equivalent commitment based on the authors measurements of ^{137}Cs and ^{134}Cs in 1986 ranged from 0.04 to 0.1 mSv.

47304 **Cesium levels in some Italian diets before and after the Chernobyl accident.** Ingrao, G.; Santaroni, G.P. (ENEA C.R.E. Cassaccia, Roma (Italy)). pp 226-231 of Trace substances in environmental health-XXI. Hemphill, D.D. (ed.). Columbia, MO; University of Missouri (1987). (CONF-8705217—).

From 21. annual conference on trace substances in environmental health; St. Louis, MO, USA (25 May 1987).

Total diets were reconstructed on the basis of a food consumption survey carried out in three different locations of Italy. The choice of these locations was made according to the different pattern of the fallout deposition from the radioactive cloud in the various Italian regions. In each location the most frequently consumed food items were collected before and after the Chernobyl accident. This was possible because of an ongoing study on trace elements intake in different socio-economical population groups. The edible part of the diets, ready for consumption, were freeze dried and analyzed by gamma spectrometry. The ^{134}Cs and ^{137}Cs ingestion levels after Chernobyl, were significantly different in the three locations increasing from south to north. The ingestion dose,

calculated on the basis of these data, is an order of magnitude higher in the north compared to that for the south. These doses, calculated using the actual food ingestion, are more realistic and result significantly lower than the doses calculated considering the radioactivity levels in the single food items and estimating their consumption from the national availability food data.

47395 **Human radiocesium levels in Scotland.** Watson, W.S. (Dept. of Clinical Physics and Bioengineering, Glasgow (Scotland)). pp 232-236 of Trace substances in environmental health-XXI. Hemphill, D.D. (ed.). Columbia, MO; University of Missouri (1987). (CONF-8705217—).

From 21. annual conference on trace substances in environmental health; St. Louis, MO, USA (25 May 1987).

The incorporation of radiocesium fallout from Chernobyl into inhabitant of the Strathclyde region of Central Scotland has been assessed by whole body activity measurements. These measurements were made in a group of 18 adult volunteers on 4 occasions in the year following the accident. A larger group of 40 subjects, including the initial 18, were measured at one year post-Chernobyl, at which time they also completed a dietary questionnaire. The levels of whole body radiocesium rose over the first 3-4 months after the accident and then plateaued at values of approximately 0.06 Bq/mmol potassium for ^{134}Cs and 0.17 Bq/mmol potassium for ^{137}Cs. Whole body radiocesium correlated with both total body potassium and milk intake but not with lamb intake. Predicted whole body radiocesium levels assuming milk to be the only source of radiocesium were in excellent agreement with the measured values. Radiation doses for the year following the accident were calculated from these levels for both children and adults. The doses were essentially independent of age from 1 year to adulthood and were small at approximately 1% of the annual background radiation dose for the members of the UK population.

5603 Chemicals Metabolism And Toxicology

REFER ALSO TO CITATION(S) 46252, 46253, 46254, 46283, 46284, 46285, 46286, 46287, 46288, 46289, 46290, 46291, 46292, 46293, 46294, 46295, 46296, 46297, 46298, 46299, 46306, 46307, 46320, 46321, 46322, 46494, 47088, 47291, 47299, 47313, 47331, 47335, 47351, 47369

47396 **(CONF-8804150—2) Cancer risk assessment: Pharmacokinetics mechanistic considerations.** Griesemer, R.A. (Oak Ridge National Lab., TN (USA)). 31 May 1988. Contract AC05-84OR21400. 8p. NTIS, PC A02/MF A01; 1; GPO Dep. Order Number DE88011838/JAW.

From Symposium on assessing the risks from toxics in the northern California environment: what science can tell us; San Francisco, CA, USA (7 Apr 1988).

A fundamental assumption in cancer risk assessments is that humans and experimental animals respond much the same way to carcinogens. This assumption is grounded on established principles of toxicology and is supported by concordant findings in those instances where both animal and human data exist. For quantitative comparisons relatively few data exist but for carcinogenic drugs the doses that produce cancer in animals and man are remarkably close, generally within an order of magnitude. Why then do advisory committees, such as EPA's Science Advisory Board, spend hours assessing the details of the information obtained from various animal species and from epidemiologic studies? One reason is that human populations are more genetically heterogeneous and have more varied lifestyles than the experimental animals used in controlled experiments. This raises the issue of the extent to which the animal bioassays can be expected to predict the responses of persons more susceptible or resistant than the population average. Secondly, differences are sometimes found in the tumor incidences or in the tumor types and locations among different animal species or strains themselves which brings into question which studies to use to extrapolate to humans. 6 refs.

47397 **(DOE/ER/60177—1) [Integration of knowledge on the response of vegetation to rising CO_2]: Final technical report, August 8, 1983-March 31, 1986.** Strain, B.R. (Duke Univ., Durham, NC (USA). Dept. of Botany). 11 Feb 1988. Contract AS05-83ER60177. 17p. NTIS, PC A03/MF A01; 1; GPO Dep. Order Number DE88014740/JAW.

The objective of this project was to review the literature and to publish reviews on the known effects of CO_2 enhancement on plants and ecosystems. Assistance was given to Dr. Roger Dahlman, CO_2 Project Director, as he prepared the research plan on vegetation response. Following one year of intensive dialog, Dr. Dahlman released the official DOE research plan and a published paper describing the need for the research. We planned, supervised and edited the production of one volume of the six volume State of the Art (SOA) Report released by DOE in December 1985. This monograph summarized relevant research and made recommendations for future needs in the area of plant response to global CO_2 increase. It is the most comprehensive treatment to date of the subject. The project required a massive literature review. In 1986 we published a bibliography with abstracts and index. A separate project was accomplished by subcontract to Dr. James Reynolds, first at NC State University and finally at New Mexico State University. Dr. Reynolds conducted a developmental study on the preparation of a generic plant growth model.

47398 **(ORNL—6469) Water quality criteria for hexachloroethane: Final report.** Davidson, K.A.; Hovatter, P.S.; Ross, R.H. (Oak Ridge National Lab., TN (USA)). Mar 1988. Contract AC05-84OR21400. 132p. NTIS, PC A07/MF A01; 1; GPO Dep. Order Number DE88013191/JAW.

The available data regarding the environmental fate, aquatic toxicity, and mammalian toxicity of hexachloroethane, which is used in military screening smokes, were reviewed. The USEPA guidelines were used to generate water quality criteria for the protection of aquatic life and its uses and of human health. 16 tabs.

47399 (PNL-SA—15217, pp 1-10) **Development of bioassay-directed chemical analysis for the identification of mutagenic chemical species in environmental samples.** Schuetzle, D. (Ford Motor Company, Dearborn, MI (USA)). 1987. NTIS, PC A99/MF A01. Order Number DE88007332/JAW. (CONF-851027—).

From 24. Hanford life sciences symposium and environmental research on complex organic mixtures; Richland, WA, USA (20 Oct 1985).

Solvent extracts of particulate matter generated from combustion sources and in ambient air are mutagenic in short-term bioassays. These samples contain hundreds to thousands of chemical components. A protocol called bioassay-directed chemical analysis was developed to facilitate identification and quantitation of important chemical species in complex environmental samples; identification of mutagenic chemical species in diesel particulate extracts is described. Factors influencing the quantitative recovery of mutagenic chemical species during extraction, fractionation, and chemical analysis are discussed. Procedures were developed to generate Ames Assay Chromatograms, used to prioritize specific chemical fractions for detailed chemical analysis. Use of this protocol to identify polar chemical mutagens is also described.

47400 (PNL-SA—15217, pp 151-165) **Chemical fractionation and bioassay of complex mixtures: studies in tobacco carcinogenesis.** Hoffmann, D.; LaVoie, E.J.; Hecht, S.S. (American Health Foundation, Valhalla, NY (USA)). 1987. NTIS, PC A99/MF A01. Order Number DE88007332/JAW. (CONF-851027—).

From 24. Hanford life sciences symposium and environmental research on complex organic mixtures; Richland, WA, USA (20 Oct 1985).

The physicochemical nature of combustion products influences their toxicity and tumorigenicity. For tobacco smoke, the chemical composition of the vapor phase, particle size, and pH, as well as air dilution and aging, are important factors. Methods for determining toxic agents in the vapor phase include direct gas chromatography/mass spectroscopy (GC/MS), trapping on molecular sieves in solvents, followed by high-performance liquid chromatography (HPLC) separation, and analysis by GC with electron capture detector (ECD), flame ionization detector, thermal energy analyzer or MS. Analyses and bioassays of volatile nitrosamines and aldehydes will be discussed. Short-term assays used for preliminary identification of contact carcinogens and tumorigenic agents in particulate matter include the Ames test, mutagenesis with mammalian cells, DNA repair assay and DNA-binding. Carcinogenic, tumor-

promoting, and cocarcinogenic activity were determined in vivo on mouse epithelium, by induction of lung adenoma in strain A mice, or upon application to newborn mice. Classical fractionation schemes or HPLC separation were chosen to concentrate tumorigenic agents from particulate matter for testing at appropriate dosage. Identification of PAH and catechols in complex mixtures as tumor initiators and cocarcinogens is discussed. Organ-specific carcinogens isolated from complex mixtures were primarily assayed by the Ames test, in strain A mice, and by subcutaneous injections in rats. The chemical identification of these carcinogens is done by specifically designed separation methods; examples are given for nonvolatile N-nitrosamines and aromatic amines.

47401 (PNL-SA—15217, pp 251-258) **Comparative mutagenicity of analogous amino- and nitropolycyclic aromatic hydrocarbons.** Plasterer, M.R.; Booth, G.M.; Lee, M.L.; West, W.R.; Smith, P.; Tedjamulia, M.L.; Tominaga, Y.; Castle, R.N. (Brigham Young Univ., Provo, UT (USA)). 1987. NTIS, PC A99/MF A01. Order Number DE88007332/JAW. (CONF-851027—). Contract AC02-79EV10237.

From 24. Hanford life sciences symposium and environmental research on complex organic mixtures; Richland, WA, USA (20 Oct 1985).

Relative mutagenicities of 17 corresponding nitro- and amino-substituted polycyclic aromatic hydrocarbons were determined using the Salmonella/microsome assay. Compounds studied were substituted anthracene, biphenyl, fluoranthene, fluorene, naphthalene, and pyrene. Relative mutagenicities showed clear correlation between the nitro and amino derivatives of naphthalene, biphenyl, fluorene, and anthracene. Statistical analysis of the linear portion of the dose-response curves for 2-nitro- and 2-aminofluorene, and 4-nitro- and 4-aminobiphenyl showed the slopes were not significantly different. Visual comparison of dose-response curves for 2-nitro- and 2-aminonaphthalene, and 2-nitro- and 2-aminoanthracene showed similar trends. Most fluoranthrene derivatives were extremely active; 8-nitrofluoranthene, which gives an estimated 340,000 revertants/μg, is one of the most mutagenic compounds reported in the literature.

47402 (PNL-SA—15217, pp 271-280) **Mutagenicity of photochemically transformed polycyclic aromatic amines.** Strniste, G.F.; Nickols, J.W.; Okinaka, R.T.; Whaley, T.W. (Los Alamos National Lab., NM (USA)). 1987. NTIS, PC A99/MF A01. Order Number DE88007332/JAW. (CONF-851027—). Contract W-7405-ENG-36.

From 24. Hanford life sciences symposium and environmental research on complex organic mixtures; Richland, WA, USA (20 Oct 1985).

Polycyclic aromatic amines (PAA) are a class of genotoxic chemicals in certain energy-related complex organic mixtures. This paper reviews studies conducted in the authors laboratory concerning photochemical transformation of PAA by near-ultraviolet (UVA) light and the increase in biological activity of radiation-generated products. Cytotoxicity and mutagenicity were measured in the Ames/Salmonella standard-plate assay; typically, in the absence of metabolic enzymes, unless determination for promutagenic chemicals was required. Chemical fractionation and identification of various photoproducts was accomplished by high-performance liquid chromatography, and ultraviolet (UV) and infrared spectrophotometry, and mass spectrometry. Photooxidation of 2-aminofluorene (2-AF) can occur at the exocyclic nitrogen and at certain ring positions, resulting in the formation of direct-acting bacterial mutagens, including 2-nitrosofluorene, 2-nitrofluorene, and 2-nitrofluoren-9-one. In addition, UVA-irradiated 2-AF solutions contain promutagenic compounds.

47403 (PNL-SA—15217, pp 387-394) **Breath analysis as a technique for complex mixture dosimetry measurements.** Weimer, W.C.; Zangar, R.C.; Springer, D.L. 1987. NTIS, PC A99/MF A01. Order Number DE88007332/JAW. (CONF-851027—).

From 24. Hanford life sciences symposium and environmental research on complex organic mixtures; Richland, WA, USA (20 Oct 1985).

Effective dosimetric techniques are needed to measure the integrated exposure of workers to components of complex mixtures in occupation environments. A potentially attractive approach is to measure specific compounds or compound classes in the breath of workers exposed to liquids, vapors, aerosols, or particles. Because a chemical equilibrium is established between the concentrations of compounds in the blood reservoir and in expired air, analysis of breath can provide a rapid and convenient indicator of compound concentrations in blood and an estimate of occupational exposure. The authors evaluated the feasibility of using breath analysis to estimate exposure to complex mixtures is rats. They determined the time course of blood and breath concentrations for a series of one-, two-, and three-ring polycyclic aromatic hydrocarbons (PAH) and substituted PAH of increasing polarity following exposure by intraperitoneal injection. They then calculated breath/blood partition coefficients for each compound. Equilibrium was established relatively rapidly after animal exposure. One-ring PAH cleared from the system within 24 hr after exposure; larger-ring-size compounds had not cleared by 24 hr. The magnitude of the partition coefficients for this series of five PAH ranges from about 0.2 for benzene to 1×10^{-6} for phenanthrene. These data suggest that breath collection and analysis may be useful for evaluating short-term exposure to chemically complex mixtures.

47404 (PNL-SA—15217, pp 591-609) **Toxic chemicals in marine environments: food-chain transfers and biological effects.** Malins, D.C.; McCain, B.B.; Brown, D.W.; Chan, S.L. (Northwest and Alaska Fisheries Center, Seattle, WA (USA)). 1987. NTIS, PC A99/MF A01. Order Number DE88007332/JAW. (CONF-851027—).

From 24. Hanford life sciences symposium and environmental research on complex organic mixtures; Richland, WA, USA (20 Oct 1985).

Hundreds of toxic chemicals occur in marine environments. Because sediments are sinks for most chemicals, the transfer of chemicals from sediments to organisms, and their subsequent transmission through food chains, is especially important. Some xenobiotics are metabolically labile, whereas others are essentially resistant to metabolism. Metabolically resistant compounds have a high potential for accumulating in marine birds, mammals, and humans. Biological transport of sediment-associated metals has received little attention. Field studies indicate that most metals are not extensively bioconcentrated in marine fish; however, they are bioconcentrated in invertebrates, such as molluscs. Studies on the nature and extent of transfer of toxic chemicals in sediments from urban environments to marine species and humans has focused primarily on single chemicals, although hundreds of chemicals are available for food-chain transfer. Nevertheless, certain chlorinated organic compounds that are transferred to fish-eating human populations have been linked to deleterious effects.

47405 (PNL-SA—15217, pp 611-620) **Environmental fate assessment for pesticides - the terrestrial component.** Quistad, G.B. (Zoecon Corporation, Palo Alto, CA (USA)). 1987. NTIS, PC A99/MF A01. Order Number DE88007332/JAW. (CONF-851027—).

From 24. Hanford life sciences symposium and environmental research on complex organic mixtures; Richland, WA, USA (20 Oct 1985).

This paper describes the methods used to evaluate the biotransformation, bioaccumulation, and biotransfer of chemicals that are deliberately applied to the environment for pest control. The author will emphasize an experimental design that is heavily influenced by the pesticide registration guidelines of the Environmental Protection Agency (EPA). Their work with the pyrethroid insecticide fluvalinate will be used to exemplify the transfer of pesticide residues from soils to plants and, ultimately, the fate of plant residues in animals (rats, chickens, rhesus monkeys, and a cow). Experimental approaches elucidating the structure of degradation products will be presented. Examples will be given to show how we proceed from metabolite identification to evaluation of toxicological significance. Their work with the milticide cycloprate will be used to demonstrate the formation of a complex mixture of metabolites in plants and animals (rats, dogs, and a cow). They have studied the bioavailability to rats of a mixture of plant metabolites from cycloprate as well as the dissipation of another mixture of lipophilic residues from rat.

47406 (PNL-SA—15217, pp 621-630) **Factors affecting bioabsorption, metabolism, and storage of organic compounds by aquatic biota.** Bean, R.M.; Dauble, D.D.; Thomas, B.L.; Hanf, R.W.; Chess, E.K. 1987. NTIS, PC A99/MF A01. Order Number DE88007332/JAW. (CONF-851027—).

From 24. Hanford life sciences symposium and environmental research on complex organic mixtures; Richland, WA, USA (20 Oct 1985).

Biological concentration and transfer of organic chemicals through aquatic food webs can be influenced by various environmental, biological, and biochemical factors. Bioaccumulation can be significantly altered by the presence of suspended matter or complex organic mixtures in water. In addition, a compound's bioaccumulation factor is dependent on the species of organism, its life stage, and the available food supply. Metabolic changes in the structure of absorbed organics can alter the rate and mechanisms of absorption and elimination. Both the absorption rate and metabolic disposition of quinoline in trout depend on whether exposure was through ingestion or the water column. These factors explain why the physical properties of organic compounds (most notably, octanol/water partition coefficients) are sometimes unreliable predictors of bioaccumulation potential.

47407 (PNL-SA—15217, pp 631-641) **Uptake and fate of phenol, aniline and quinoline in terrestrial plants.** Cataldo, D.A.; Bean, R.M.; Fellows, R.J. 1987. NTIS, PC A99/MF A01. Order Number DE88007332/JAW. (CONF-851027—).

From 24. Hanford life sciences symposium and environmental research on complex organic mixtures; Richland, WA, USA (20 Oct 1985).

The bioavailability and chemical fate of xenobiotics in terrestrial plants can influence the impact of fossil fuel development on the human food chain. To determine the relative behavior of organic residues representing a range of chemical classes, the authors compared the rates of root absorption, tissue distribution and chemical fate of phenol, aniline and quinoline in soybean plants. Root absorption rates for these compounds were 180, 13 and 30 μg/g (fresh weight) root/day, respectively. Following uptake, aniline was concentrated in the root, while phenol and quinoline were evenly distributed in roots and leaves. After accumulation, phenol was readily decomposed, and its carbon was respired. While aniline was susceptible to oxidative decomposition, it persisted in leaves and roots; 25% of the soluble activity represented aniline, and a significant fraction was bound or conjugated to cell constituents. Quinoline persisted both in the parent form and as metabolic products. However, in leaves, additional compounds were found that were chemically similar to quinoline; these were not found in unexposed plants. A substantial fraction of the quinoline accumulated by leaves was emitted to the atmosphere by volatilization.

47408 (PNL-SA—15217, pp 667-682) **Quantitative studies of environmental risk: an overview.** Morgan, M.G. (Carnegie-Mellon Univ., Pittsburgh, PA (USA)). 1987. NTIS, PC A99/MF A01. Order Number DE88007332/JAW. (CONF-851027—).

From 24. Hanford life sciences symposium and environmental research on complex organic mixtures; Richland, WA, USA (20 Oct 1985).

This paper reviews a variety of basic ideas and issues in risk analysis, assessment and management. A four-part framework composed of exposure, effects, human perception, and human valuation processes is introduced and used to organize the discussion. Because many participants in this conference have interests in, or are practitioners of, quantitative risk analysis, the author will also focus on three fundamental problems commonly encountered in quantitative risk analysis: selection of objective functions and management strategies, characterization and treatment of scientific and technical uncertainty, and what to do when experts disagree. The arguments will be illustrated with examples from the literature.

47409 (PNL-SA—15217, pp 703-716) **Lung retention of inhaled aromatic hydrocarbons in pure forms or associated with particulate matter.** Bond, J.A.; Sun, J.D.; Mitchell, C.E.; Wolff, R.K.; Dutcher, J.S.; McClellan, R.O. (Inhalation Toxicology Research Institute, Albuquerque, NM (USA)). 1987. NTIS, PC A99/MF A01. Order Number DE88007332/JAW. (CONF-851027—). Contract AC04-76EV01013.

From 24. Hanford life sciences symposium and environmental research on complex organic mixtures; Richland, WA, USA (20 Oct 1985).

Organic compounds, including polycyclic aromatic hydrocarbons (PAH), nitro-PAH, aromatic amines, and azaarenes, have been detected in emissions, products, and by-products associated with energy production and use. These chemicals typically exist in the atmosphere as part of complex chemical mixtures, either as vapors or adsorbed onto respirable particles. A paucity of data is available on the potential health risks associated with exposure to these chemicals either in pure forms or associated with particles. The authors report lung retention data for benzo[a]pyrene, 1-nitropyrene, 2-aminoanthracene, dibenzo[c,g]carbazole, and phenanthridone, both in pure forms and associated with carbonaceous, organic, and inorganic particles. The F344 rats were exposed nose-only to aerosols of the different chemicals (pure and on particles) for 30 to 60 min; comparisons were made of lung retention of the inhaled chemicals. Results showed that, in general, when the chemical was inhaled in its pure form, over 99% of the inhaled material was cleared rapidly from lungs with half-times of < 1 day. However, when the chemical was inhaled on carrier particles, a significant fraction was retained in the lungs (up to 50%), and this fraction cleared with half-times of > 1 day. Thus, the biological fate of inhaled chemicals is dependent, to some degree, on the form in which it is inhaled.

47410 (PNL-SA—15217, pp 717-723) **Epidemiological bases for assessing health effects of exposure to complex organic mixtures: need for evaluation.** Morris, S.C. (Brookhaven National Lab., Upton, NY (USA)). 1987. NTIS, PC A99/MF A01. Order Number DE88007332/JAW. (CONF-851027—).

From 24. Hanford life sciences symposium and environmental research on complex organic mixtures; Richland, WA, USA (20 Oct 1985).

Health effects of exposure to complex organic mixtures must be estimated for many occupational and environmental situations. Epidemiologic results play an important role in this process. Extrapolations from studies of coke-oven workers, gas-retort workers, etc., have been used to estimate potential health effects of exposure to a variety of complex organic mixtures, including diesel car exhaust, synthetic fuel plant emissions, and wood smoke. None of these epidemiologic studies, however, fits the authors need exactly. Moreover, populations that have not yet been studied may provide more appropriate data for a particular case than the data now available. This paper describes several epidemiologic studies for which results are now available, as well as potential opportunities for epidemiologic study. It then sets forth criteria to evaluate these opportunities in terms of suitability for various applications and strengths of the study itself.

47411 (PNL-SA—15217, pp 725-735) **Mixtures of toxic agents and the risk of health effects.** Seiler, F.A. (Inhalation Toxicology Research Institute, Albuquerque, NM (USA)). 1987. NTIS, PC A99/MF A01. Order Number DE88007332/JAW. (CONF-851027—). Contract AC04-76EV01013.

From 24. Hanford life sciences symposium and environmental research on complex organic mixtures; Richland, WA, USA (20 Oct 1985).

A method is presented to analyze the health risks associated with a combination of insults, such as exposures to complex organic mixtures. The approach is phenomenological, has no built-in restrictions, and treats synergistic and antagonistic interactions between effects of various toxicants in a general manner. The only restrictions arise from the finite size of the set of functions used to describe the cause-effect relationships with low doses and minimal effects. Examples with two complex mixtures involve analyses of

data on oral and esophageal cancer associated with chronic consumption of alcohol and tobacco. An example of combined exposure to a complex mixture and a specific toxicant involves analysis of lung cancer incidence in uranium miners who smoke. Finally, this formalism will be used to plan cost-effective experiments involving two toxicants or two mixtures of toxicants.

47412 (PNL-SA—15217, pp 747-757) **Approaches to the quantitative estimation of health risk from exposure to chemical mixtures.** Hertzberg, R.C.; Patterson, J. (Environmental Protection Agency, Cincinnati, OH (USA)). 1987. NTIS, PC A99/MF A01. Order Number DE88007332/JAW. (CONF-851027—).

From 24. Hanford life sciences symposium and environmental research on complex organic mixtures; Richland, WA, USA (20 Oct 1985).

Developing methods to assess human health risks from combinations of environmental pollutants is a challenge that the US Environmental Protection Agency (EPA) recently began addressing. To standardize the Agency's approaches, the EPA drafted guidelines for health risk assessment of chemical mixtures that describe the nature of the problem, offer a decision framework for risk assessment, and discuss general procedures for estimating risk. Two types of procedures are described: assessment of the mixture of concern, and estimation of risk, based on toxicological information on the mixture's components. Risk estimation based on mixture data follows procedures used for single chemicals. For assessments based on component data, the guidelines recommend a dose-additive model for similar acting threshold toxicants and a risk-additive model for carcinogens. An extensive effort was initiated to compile known information on toxic interactions, including toxicity data, statistical techniques used to determine interactions, and theories on mechanisms. The project includes a computer database containing over 1200 toxicity studies. Initial data review indicates that authors most often use dose addition or response addition to determine expected response. Whole-body responses dominated the studies, and nearly 80% of experimental exposures were less than 90 days.

47413 (UCRL—21001-88-4) **Research plan for: Comparison of the response of mature branches and seedlings of {ital Pinus ponderosa} to atmospheric pollution.** Houpis, J.L.J.; Surano, K.A.; Cowles, S.; Shinn, J.H. (Lawrence Livermore National Lab., CA (USA)). Jan 1988. Contract W-7405-ENG-48. 155p. NTIS, PC A08. Order Number DE88013878/JAW.

This research proposes to investigate a potential method for quantifying the effect of air pollutants on mature trees by exposing intact mature branches using a branch exposure system. There are three main objectives. The first objective is the development and testing of a branch exposure chamber. Our second objective is to document if a branch exposure chamber is a valid research method by testing for branch autonomy in mature {ital Pinus ponderosa}. This will involve measuring how much translocated carbon a branch receives from neighboring branches and the effect of canopy position. In addition, we will be researching how ozone exposure will affect branch autonomy. These questions will determine if the degree of damage or repair in the branch enclosed in the branch exposure chamber is independent of the rest of the plant. If individual branches do not respond autonomously to the imposed stress, branch exposure chambers are not feasible alternatives for pollution exposure studies of {ital Pinus ponderosa}. 87 refs., 11 figs., 14 tabs.

47414 **Chemical scoring by a rapid screening of hazard (RASH) method.** Jones, T.D.; Walsh, P.J.; Watson, A.P.; Owen, B.A.; Barnthouse, L.W.; Sanders, D.A. (Oak Ridge National Lab., TN (USA)). *Risk Analysis;* **8**: No. 1, 99-118(Mar 1988).

A rapid screening of hazard method (RASH) is presented for deriving relative potency estimates for hazardous substances. The method utilizes data from any available toxicological database such as the Registry of Toxic Effects of Chemical Substances (RTECS) or EPA's GENE-TOX database on genetic activity profiles. The method has been applied to derive relative potency values and permissible environmental concentrations for 278 chemicals. The derived values have been compared with recommendations of expert committees where possible, and substantial agreement is found.

47415 **No evidence found for induction of dominant lethal mutations and heritable translocations in male mice by calcium cyclamate.** Cain, K.T.; Cornett, C.V.; Cacheiro, L.A.; Hughes, L.A.; Owens, J.G.; Generoso, W.M. (Oak Ridge National Lab., TN (USA)). *Environmental and Molecular Mutagenesis;* **11**: No. 2, 207-218(1988). Contract AC05-84OR21400.

Calcium cyclamate, an artificial sweetener, was studied for its effectiveness in inducing transmissible chromosomal aberrations in germ cells of male mice. Both the dominant-lethal and the heritable translocation tests were carried out following daily treatment (on weekdays) of males by oral intubation with the maximum tolerated dose for 6 weeks. Calcium cyclamate is negative in both tests; therefore, there is no evidence of induced chromosome breakage and exchange.

47416 **Trace substances in environmental health-XXI.** Hemphill, D.D. (ed.). Columbia, MO; University of Missouri (1987). 631p. (CONF-8705217—).

From 21. annual conference on trace substances in environmental health; St. Louis, MO, USA (25 May 1987).

The Twenty-first Annual Conference on Trace Substances in Environmental Health in order to encourage interdisciplinary discussions and interactions. The purpose of the meeting was to explore the biological, economic and health significance of the numerous inorganic and organic substances which are present, normally, in trace amounts in our environment, particularly in air, food and water. Separate abstracts have been prepared for the data bases.

5604 Other Environmental Pollutant Effects

47417 **Microwaves and the cell membrane. IV. Protein shedding in the human erythrocyte: quantitative analysis by high-performance liquid chromatography.** Liburdy, R.P.; Rowe, A.W.; Vanek, P.F. Jr. (Lawrence Berkeley Lab., CA (USA)). *Radiation Research;* **114**: No. 3, 500-514(Jun 1988).

The erythrocyte responds to microwave fields by shedding at least 11 low-molecular-weight proteins of less than or equal to 31,000 Da, with components of 28,000-31,000 Da released during the destabilization of divalent calcium-protein bridges. Significantly, protein shedding was shown to be restricted to exposure temperatures coinciding with the cell membrane phase/structural transition temperature, Tc, of 17-25°C. We report here a further characterization of protein shedding at Tc using high-performance liquid chromatography and membrane-associated blood group antigen testing. Proteins shed from human erythrocytes in microwave fields (2450 MHz, CW) compared to sham-heating displayed a twofold increase in total protein mass released concomitant with the appearance of unique protein species during reverse-phase, hydrophobic interaction, and anion-exchange HPLC. These HPLC analyses indicate that microwaves result in the shedding of proteins which are relatively nonpolar and hydrophobic and which carry a net positive electrostatic charge compared to those released during sham-heat treatment. Assessment of 23 blood group antigens that represent integral protein markers on the erythrocyte cell surface indicates that microwave fields do not result in the exhaustive loss of these proteins. The class of proteins that is shed in response to microwave fields most likely is the loosely bound peripheral or extrinsic proteins associated with the exterior of the cell surface. Such proteins play a major role in the transduction of signals to integral membrane proteins which span the bilayer. That this class of proteins is susceptible to release by microwave fields is discussed in relation to microwave absorption at the cell surface by membrane-associated bound water, field interaction with dipolar side groups, and the disruption of divalent cation bridges known to stabilize peripheral membrane proteins.

57 HEALTH AND SAFETY

REFER ALSO TO CITATION(S) 46455, 47385

47418 **(CONF-8805157—1) The integrated local flood warning system: A look at the flood response system.** Neal, D.M.; Lee, R. (Oak Ridge National Lab., TN (USA)). 1988. Contract AC05-84OR21400. 8p. NTIS, PC A02/MF A01; 1; GPO Dep. Order Number DE88012931/JAW.

From Association of State Floodplain Managers meeting; Nashville, TN, USA (16 May 1988).

Local Flood Warning Systems are instituted and maintained at a local level. They consist of two parts: (1) the flood forecast system, and (2) the flood response system. The flood forecast system is primarily built around the technology used to predict flooding. In this paper, we stress two points about local flood warning systems. First, the system must be integrated. Specifically, collecting data, transmitting data, forecasting the flood, informing local officials, warning local residents, and taking protective action (including evacuation of residents) must all occur in an integrated fashion if the whole system is to succeed. Second, we outline some important organizational characteristics that should be improved when developing a local flood response system. Key organizational characteristics include experience, networks, communications, decision making, everyday disaster task overlap. By focusing upon experience (including learning from the past flood or disaster experience or participating in drills and exercises) and by improving preparedness can be inexpensively improved. 6 refs.,

47419 **(EGG-M—88106) A stochastic model for high-let response for boron neutron capture therapy (BNCT).** Wheeler, F.J.; Griebenow, M.L.; Wessol, D.E.; Nigg, D.W.; Anderl, R.A. (EG and G Idaho, Inc., Idaho Falls (USA)). [1988]. Contract AC07-76ID01570. 15p. (CONF-8802102—1). NTIS, PC A03/MF A01; GPO Dep. Order Number DE88015094/JAW.

From BNL BNCT workshop; Upton, NY, USA (1 Feb 1988).

It will be important to have comprehensive analytical models for BNCT. Such models, validated by experiment, will provide the detailed neutron and gamma flux and interaction rate distributions within tissue. Measured tumor size, location, and boron content (including available information on the microscopic inter/intracellular boron distributions) will be employed in the models. Information of use to the radiation oncologists will be conveniently displayed on computer graphics systems in a time period such that irradiation-time requirements, irradiation-field selection, and beam tailoring can be determined after boron concentrations and other physical data are established. For the primary high-LET effects from charged-particle slowing down, simple concepts such as dose and relative biological effectiveness (RBE) are inadequate for correlation with tissue response. Stochastic models and simulation studies are required to estimate cellular survival. A stochastic model recently proposed and applied to low-level, low-dose mutation effects is being accepted as an alternative to dose and RBE. This is the hit size effectiveness function introduced by Bond, et al. A similar approach for analytical event-oriented modeling for high-LET effects for BNCT is described in this paper. This model is applicable to multi-event response when the response is independent of other events. A trial study was performed to assess endothelium response during BNCT. The results of this study are only qualitative at this time, but suggest that the endothelium may be more tolerant than would be expected based on dose and RBE considerations. 12 refs., 6 figs., 2 tabs.

58 GEOSCIENCES

5801 Geology And Hydrology

REFER ALSO TO CITATION(S) 46304, 46305, 46400, 47364

47420 **(DOE/NV/10583—1) Physical properties and radiometric age estimates of surficial and fracture-fill deposits along a portion of the Carpetbag fault system, Nevada Test Site, Nye County, Nevada.** Shroba, R.R.; Muhs, D.R.; Rosholt, J.N. (Geological Survey, Denver, CO (USA)). Jul 1988. Contract AI08-86NV10583. 34p. NTIS, PC A03/MF A01; 1; GPO Dep. Order Number DE88013830/JAW.

Surficial deposits and fracture-fill deposits (fracture fillings that consist chiefly of calcium carbonate-cemented, pebbly sand) were studied along a 2.5-km-long portion of the Carpetbag fault system in an area characterized by prominent, explosion-produced scarps and a shallow graben that formed during and subsequent to the 1970 Carpetbag nuclear event in the northwestern part of Yucca Flat, Nevada Test Site. The surficial deposits are fluvial and slopewash deposits and mixed eolian sediment that range in grain size from pebble gravel to silty sand. These deposits have been modified by the accumulation of varying amounts of pedogenic silt, clay, calcium carbonate, and probably opaline silica. Despite the occurrence of ancient fractures and linear features on aerial photographs, that are near and parallel to subsurface faults of the Carpetbag system, no other evidence for prehistoric surface faulting was observed in the study area. The lack of prehistoric fault scarps and the lack of offset of stratigraphic contacts exposed in trench excavations suggest that no significant vertical surface displacement has occurred on the Carpetbag system during the past 125,000 years and possible during the past 350,000 years. 39 refs., 12 figs., 8 tabs.

47421 **(LBL—25489) A study of the application of mercury porosimetry method to a single fracture.** Tsang, Y.W.; Hale, F.V. (Lawrence Berkeley Lab., CA (USA)). Jun 1988. Contract AC03-76SF00098. 19p. (CONF-880583—2). NTIS, PC A03/MF A01; 1; GPO Dep. Order Number DE88013598/JAW.

From International conference on fluid flow in fractured rocks; Atlanta, GA, USA (15 May 1988).

In recent years, there is increasing evidence both in the field and in the laboratory that the fluid flow in low permeability fractured media is unevenly distributed and predominantly occurs in selected preferred paths. In view of the experimental observation of flow channeling, conceptual models have been developed to interpret fluid flow and transport in fractured media as through a system of statistically equivalent channels, and to relate permeability and tracer transport measurements to fracture aperture parameters. Mercury porosimetry has long been used to study the void space of porous materials. In this paper, we apply the concept of mercury porosimetry for porous rock to a rock fracture by simulations of mercury intrusion and withdrawal in a single fracture with variable apertures. Our theoretical studies show that the total capillary pressure curve in a pressure-controlled test gives information on the distribution of all the apertures which control the tracer transport through the fracture. On the other hand, the second intrusion curve in a pressure-controlled experiment resembles the rison part of a rate-controlled experiment, and gives information on the small aperture distribution which control the flow permeability of the fracture. The ratio of the limiting mercury volumes of the second intrusion and the first intrusion capillary curves can confirm estimates of equivalent apertures derived from permeability and tracer transport measurements. Lastly, the fraction of trapped mercury may be related to the spatial correlation of the aperture variation in the fracture. 12 refs., 9 figs.

47422 **(ORNL/TM—10803) Soil and surficial geology guidebook to the Oak Ridge Reservation, Oak Ridge, Tennessee.** Lee, S.Y.; Lietzke, D.A.; Ketelle, R.H.; Ammons, J.T. (comps.). (Oak Ridge National Lab., TN (USA)). Jun 1988. Contract AC05-84OR21400. 93p. NTIS, PC A05/MF A01; 1; GPO Dep. Order Number DE88013512/JAW.

This soil and surficial geology guidebook was prepared primarily for the field trip of the Southern Regional Soil Survey Work Planning Conference to be held in Knoxville, but will be available for future field trips of other regional, national, and international conferences related to soil and geomorphic research. This guidebook is organized into: (1) introduction to be Oak Ridge area; (2) geologic and hydrologic setting: (3) soil, surficial geology, and geomorphic relations; and (4) sitelogs, including soil description and characterization data. Physical, chemical, mineralogical, and engineering characterization of soils described in this guidebook is in progress. This guidebook will be revised when the characterization project is completed. Soil survey and characterization studies were begun about 5 years ago to support the Nuclear and Chemical Waste programs at ORNL and at the Oak Ridge Y-12 Plant. 15 refs; 8 figs; 6 tabs.

47423 **(PNL—6488) Characterization of unsaturated hydraulic conductivity at the Hanford Site.** Rockhold, M.L.; Fayler, M.J.; Gee, G.W. (Pacific Northwest Lab., Richland, WA (USA)). Jul 1988. Contract AC06-76RL01830. 92p. NTIS, PC A05/MF A01; 1; GPO Dep. Order Number DE88014687/JAW.

This report details some recent field measurements and compares predicted and measured values of hydraulic conductivities for three locations at the Hanford Site. Measurements from small (6-cm-dia) {open←quotes}point{close←quotes} and large (2-m by 2-m) {open←quotes}plot{close←quotes} areas utilized inflitration and drainage techniques to obtain in situ data for field-saturated and unsaturated hydraulic conductivity. The Guelph permeameter was used for point sampling, and the unsteady drainage-flux method was used on plots for field-saturated and unsaturated hydraulic conductivity measurements. Steady-state techniques were used to measure unsaturated hydraulic conductivities in small columns in the laboratory for one of the three soils tested to provide a comparison with data obtained from the field. Measured unsaturated hydraulic conductivities and those predicted from particle-size distribution and bulk density data agree within one-half to one and one-half orders of magnitude, depending on soil type. To use a particle-size distribution to estimate water retention characteristics and, subsequently, to predict unsaturated hydraulic conductivities, measurements of water-retention characteristics are necessary to determine a parameter value used in one of the models. No single method for measuring or calculating unsaturated hydraulic conductivities was found appropriate for all Hanford Site soils. Ideally, several methods should be used to take advantage of the strengths of each method, considering the data needs and resources available. 45 refs., 24 figs., 19 tabs.

47424 **(SAND—86-0940) Transport of solutes through unsaturated fractured media: Nevada Nuclear Waste Storage Investigations Project.** Dykhuizen, R.C. (Sandia National Labs., Albuquerque, NM (USA)). Mar 1988. Contract AC04-76DP00789. 16p. NTIS, PC A03/MF A01; 1; GPO Dep. Order Number DE88014700/JAW.

A numerical model is presented to represent the transport of solutes through a highly fractured unsaturated, porous medium. To accomplish this, the solute is tracked separately in two flow systems a matrix pore flow system and a fracture network, with interaction terms. Compatible hydraulic equations for such a dual system are also presented to enable solution of the solute trasport. The hydraulic equations chosen use the equivlaent porous media concept. These equations can also be applied to a saturated medium without modification. However, many of the transport terms will be negligible for such an application. A brief sample calculation illustates the method. 11 refs., 4 figs.

47425 **(UA—8013748) Geology of the Hog Mountain tonalite and associated lode gold deposits, Northern Alabama Piedmont: Final report for the 1986-1987 project year.** Green, N.L.; Lesher, C.M. (Alabama Univ., University (USA). Dept. of Geology). Feb 1988. 106p. School of Mines and Energy Development, Univ. of Alabama, Box 6282, University (Tuscaloosa), AL 35486. Order Number TI88013748/JAW.

The Hog Mountain tonalite intrudes lower Paleozoic graphitic phyllites of the Wedowee formation and is transgressed by a series of planar, en echelon, bifurcating, auriferous quartz-sulfide veins with well-defined sericite-sulfide alteration envelopes. Least-altered tonalite is white, medium-grained, and weakly to non-foliated. It is characterized by moderately uniform distributions of quartz and oscillatory-normal zoned plagioclase (An{sub 7-41}), with minor amounts of biotite, muscovite, ilmenite, apatite, zircon and corroded garnet; K-feldspar is rare. Least-altered granitoids are peraluminous (A/CNK $>$ 1.15), exhibit significant major- and trace-element variations, are characterized by relatively low REE contents, and have moderately high {delta}{sup 18}O (+9.7 to +11.2 %) and uniform {delta}D (-82 to -78 %) values. Biotite log (X{sub Mg}/X{sub Fe})-log(X{sub F}/X{sub OH}) relations suggest contamination of an I-type granitic melt by graphitic metapelites. Corroded garnets (Pyr{sub 3}Alm{sub 55}Spess{sub 17}Gross{sub 25}) within the granitoids are chemically-similar to euhedral garnets in adjacent schists and in fine-grained, foliated plagioclase-biotite-muscovite-ilmenite xenoliths, and were probably derived from the metasedimentary host rocks. Equilibration conditions of the xenolith mineral assemblages (465-510{degree}C at ca. 6 kb), calculated using garnet-biotite-muscovite-plagioclase thermobarometry, are similar to inferred metamorphic P-T conditions of underthrusting of Wedowee metasediments to mid-crustal levels during Paleozoic crustal thickening. Observed chemical variations may be modeled by plagioclase/biotite-controlled fractionation of a peraluminous tonalitic melt, accompanied by local cumulus mineral-intercumulus liquid segregation and graphitic metapelite contamination during emplacement. 70 refs., 20 figs.

47426 **Tree ring-based reconstruction of annual precipitation in the South-Central United State from 1750 to 1980.** Blasing, T.J.; Stahle, D.W.; Duvick, D.N. (Oak Ridge National Lab., TN (USA)). *Water Resources Research;* 24: No. 1, 163-171(Jan 1988). Contract AC05-84OR21400.

A 231-year reconstruction of annual precipitation, from 1750 through 1980 A.D., was developed from 10 tree ring chronologies (9 post oak, Quercus stellata, and 1 white oak, Q. alba, series) in the south-central United States. Straight line regression was used to calibrate regionally averaged precipitation with ring width data, and the derived reconstruction was verified with independent climatic data and historical evidence. A variance trend in the tree ring data, which may have resulted from nonclimatic factors, was removed. The reconstructed precipitation series indicates that (1) a drought which appears to have been more severe than any in the instrumental record occurred about 1860 and (2) severe and prolonged droughts comparable to twentieth century events have occurred at roughly 15- to 25-years intervals throughout the past 231 years. It follows that serious droughts in the south-central United States could be expected to recur even in the absence of projected CO_2-induced warming.

5802 Geophysics

47427 **(DOE/ER/13749—T1) Investigations of ultrasonic surface wave interaction with porous saturated rocks.** Adler, L. (Ohio State Univ., Columbus (USA). Dept. of Welding Engineering). 1988. Contract FG02-87ER13749. 14p. NTIS, PC A03/MF A01; 1; GPO Dep. Order Number DE88013218/JAW.

During the first year of this research project we initiated several studies on ultrasonic wave interaction with fluid-filled materials. We studied bulk and surface wave generation and propagation on naturally occurring rocks, as well as in ceramic and metallic sintered materials. 2 refs., 8 figs.

47428 **(LA—11323-MS) A review of historic and instrumental earthquake activity and studies of seismic hazards near Los Alamos, New Mexico.** House, L.S.; Cash, D.J. (Los Alamos National Lab., NM (USA)). Jun 1988. Contract W-7405-ENG-36. 41p. NTIS, PC A03/MF A01; 1; GPO Dep. Order Number DE88015058/JAW.

Several studies of seismic hazards and seismic risk have been done for the Los Alamos area. The most comprehensive one was completed in 1972 and was intended for design engineering for the TA-55 Plutonium Facility. This study concluded that a peak horizontal acceleration of 0.33 g was appropriate for design of facilities

at TA-55 since it was "unlikely to be exceeded." Progress in several areas of earthquake studies in the past 15 years has provided an improved understanding of earthquake occurrence and recurrence, as well as an improved ability to estimate ground response resulting from possible local earthquakes. Because the results of the 1972 study are still being used for seismic design of new facilities at Los Alamos, the seismic hazards and risks for Los Alamos should be reevaluated in order to confirm that the 1972 results are still meaningful and valid. Such a reevaluation is, however, beyond the scope of this report. 49 refs., 9 figs., 1 tab.

47429 **(NP—8770276) Application of converted waves in exploration seismics. Final report.** Dohr, G.; Fertig, J.; Echterhoff, J.; Behle, A.; Szelwis, J.; Tessmer, G.; Engelhard, L.; Neupert, F.; Kim, J.Y.; Behrens, J. (Preussag A.G. Erdoel und Erdgas, Hannover (Germany, F.R.); Bundesministerium fuer Forschung und Technologie, Bonn (Germany, F.R.); Technische Univ. Braunschweig (Germany, F.R.). Inst. fuer Geophysik und Meteorologie; Prakla-Seismos G.m.b.H., Hannover (Germany, F.R.)). Mar 1986. 506p. (In German). NTIS (US Sales Only), PC A22. Order Number DE88770276/JAW.

This report presents the results of 8 research projects concerning special problems in the exploration using converted waves. The correlation of shear-wave sections with well-data is an important tool in lithologic/stratigraphic studies. Experiences with a shear-wave VSP and the observation of converted waves in boreholes as well as the calculation of V/sub p/, V/sub s/ and V/sub p//V/sub s/ logs using 'full wave train analysis' from microseismograms is a part of this problem. An algorithmus for stacking PS waves and the calculation of V/sub s/ in near surface layers by means of the inversion of Rayleigh-waves give an important contribution to the processing and interpretation of shear and converted waves. The application of the IPA-package (interactive pattern analysis) on shear and P-wave sections shows significant variations of selected physical parameters in a sand formation with changing facies. The S/sup */-wave required by theoretical investigations was proven experimentally by model-seismic work and studied with reference to their origin and propagation. Converted waves will become more important in the future due to their cost effectiveness compared to pure shear-waves. (orig.) With 210 figs., 160 refs., 15 tabs.

5803 Mineralogy, Petrology, And Rock Mechanics

REFER ALSO TO CITATION(S) 47425

47430 **(LBL—25308) Hollow cylinder tests for studying fracture around underground openings.** Ewy, R.T.; Cook, N.G.W.; Myer, L.R. (Lawrence Berkeley Lab., CA (USA)). May 1988. Contract AC03-76SF00098. 8p. (CONF-880654—11). NTIS, PC A02/MF A01; 1; GPO Dep. Order Number DE88013601/JAW.

From 29. U.S. symposium on rock mechanics; Minneapolis, MN, USA (13 Jun 1988).

We are beginning a study of deformation and fracture around underground openings through experiments on thick-walled hollow cylinders of rock that incorporate several features: plane strain loading, the ability to impose different stress paths, and 'freezing' of the fracture geometry under load. The elastic moduli calculated from the measured deformations are different than the moduli reported from uniaxial compression tests. The 'unconfined' strength of the rock surrounding the hole is two to three times typical uniaxial strengths, and a confining stress in the hole strengthens the rock. Although the load is axisymmetric m, there is a preferred direction of failure. Failure is by brittle spalling, resulting in triangular failed regions with pointed tips. The extent of failure is influenced by stress path and perhaps by strain rat. 18 refs., 6 figs.

5804 Geochemistry

REFER ALSO TO CITATION(S) 47425

47431 **Arsenic geochemistry in geothermal systems.** Ballantyne, J.M.; Moore, J.N. (Univ. of Utah Research Institute, Salt Lake City (USA)). *Geochimica et Cosmochimica Acta;* 52: No. 2, 475-483(Feb 1988).

Arsenic is an important trace constituent in geothermal fluids, ranging in concentration from less than 0.1 to nearly 50 ppm. An evaluation of published fluid analyses from geothermal systems indicates that the As content of the reservoir fluids varies inversely with P/sub H_2S/ and directly with temperature. Aqueous As species occur in two oxidation states, As/sup III/ and As/sup V/. As/sup III/ predominates in the reservoir fluids, where H_3AsO_3 is inferred to be the dominant aqueous species. Both AS/sup III/ and As/sup V/ occur in hot spring fluids. The concentration of As in high-temperature reservoir fluids is regulated by reactions involving pyrite. Concentrations up to 3.8 weight percent As have been measured in pyrite from two systems. The erratic distribution of As in the samples studied is interpreted as resulting from local fluctuations in redox conditions. Arsenopyrite and other As minerals are undersaturated with respect to the high temperature fluids found in most reservoirs. In contrast, orpiment, realgar, As-rich stibnite and marcasite, and iron oxides control the deposition of As in hot spring environments. These minerals become stable in response to decreasing temperature and pH and increasing P/sub O_2/.

5805 Oceanography

REFER ALSO TO CITATION(S) 47323

47432 **(CONF-8804167—1) How much shelf production reaches the deep sea?.** Walsh, J.J. (University of South Florida, St. Petersburg (USA). Dept. of Marine Science). 1988. Contract FG05-85ER60285. 24p. NTIS, PC A03/MF A01; 1; GPO Dep. Order Number DE88014315/JAW.

From 53. Dahlem workshop on productivity of the ocean: present and past; Berlin, F.R. Germany (24 Apr 1988).

Moored arrays of fluorometers, sediment traps, and current meters on the continental margins of the Atlantic and Pacific Oceans suggest that 30–47 g C m/sup {minus}2/ yr/sup {minus}1/ might exit the shelf-break as particulate organic carbon (POC), falling towards slope depocenters (32.5 {times} 10^6 km^2). Such an annual carbon loading of 1.0–1.5 {times} 10^9 tons C yr/sup {minus}1/ is consistent with both neglected pCO_2 fluxes across the air-sea interface of continental shelves and a terrestrial source of CO_2 from deforestation. Apparently 5–16 g C m/sup {minus}2/ yr/sup {minus}1/ of the phytodetritus survive oxidation during their descent to the top of the 20–25 m bottom boundary layer on the mid-slope, where this near-bottom flux is equivalent to the total POC rain at a depth of 2000 m in the deep sea. Estimates of bottom metabolism, carbonate dissolution, and sediment accumulation suggest that {approximately} 50–100% of the near-bottom flux may be consumed during early diagenesis, with evolution of additional biogenic CO_2 as a coastal sink within the bicarbonate cycle. The physical flow regimes in eastern and western boundary currents are consistent with both the supply of nutrients for "new" production and the lateral export of organic matter to the deep sea. Anthropogenic nutrient sources could presumably account for at most 0.4–0.5 {times} 10^9 tons C yr/sup {minus}1/ of the estimated shelf export. Spatial inhomogeneity and seasonality of biological processes at the margins of ocean preclude further refinement of these estimates, however, until additional fields and theoretical studies are conducted on element fluxes between these regions and the deep sea. 25 refs., 1 fig., 1 tab.

47433 **(DOE/ER/60333—2) West Coast Physical Oceanography Program: [Annual technical progress report]: A short report 2.** Hickey, B.M. (Washington Univ., Seattle (USA). School of Oceanography). 1986. Contract FG05-85ER60333. 65p. NTIS, PC A04. Order Number DE88013231/JAW.

Ten current meter mooring (35 current meters, 4 sediment traps) were deployed in October 1985 on the R/V NEW HORIZON and recovered in February 1986 on the R/V SPROUL. Mooring location and array design are shown in the cruise report. Initial data processing has begun. The data set is remarkably error free and indicates large coherent signals over the continental slopes. Mean flow above 200 m was northwestward on the eastern side of the basin and southeastward on the west side of the basin. The total of 88 CTD stations alone 9 sections were taken during an October cruise. Rough sections have been made available to other investigators. Only 36 CTD stations along 6 sections were taken in February due to the loss of the CTD. A second CTD, borrowed from SIO, only operated for one station. The CTD was snagged on the undercut rock walls of Redondo submarine canyon. The CTD was subsequently recovered by the SNOOPER, a manned submersible. Damage was slight--a new cage was required and 3 bottles were lost. The CTD has been refurbished and recalibrated and a new cage has been built. The cage has been modified to accept the larger 30-I bottles utilized by Vic Noshkin, so that his sampling time can be drastically reduced--i.e., he can use the Rosette rather than hang bottles on a line. 2 refs., 8 figs., 4 tabs.

47434 **(DOE/ER/60336—2) Primary production, nutrients, and particulate matter in the Southern California Bight: Contribution to the C, N, and O_2 budgets: Goals, priorities and technical progress, June 1986.** Eppley, R.W. (California Univ., San Diego, La Jolla (USA). Inst. of Marine Resources). Jun 1986. Contract FG05-85ER60336. 11p. NTIS, PC A03. Order Number DE88013869/JAW.

The goal of this work is to determine the spatial and temporal variations in the planktonic primary productions and to estimate the sinking flux of biogenic carbon leaving the surface layer by measuring new production. New production is that fraction of the primary production that drives the sinking flux of biogenic organic particles. It is the production due to nutrients that enter the euphotic zone from the outside, such as those mixed up from deep water or those scrubbed out of the atmosphere by rain. The rest of the primary production is based upon nutrients recycled within the euphotic zone and is called regenerated production. In practice, new production is usually measured as the rate of nitrate assimilated by the plankton, calculated in carbon units. Nitrate is present in concentrations up to 40 micromolar several hundred meters below the euphotic zone in the North Pacific Ocean while it is usually depleted from local surface waters. In the Southern California Bight nitrate is usually present in the lower part of the euphotic zone. Concentrations increase with depth reaching maximum values at about 1000 m. The region of increasing nitrate with depth is called the nitracline. Only the upper part of the nitracline is in the euphotic zone where there is enough light for plant growth. 10 refs., 2 figs., 2 tabs.

47435 **(DOE/ER/60337—3) Role of bacteria in organic matter fluxes in the Southern California Coastal Zone: [Progress report].** (California Univ., San Diego, La Jolla (USA). Inst. of Marine Resources). Jul 1988. Contract FG05-85ER60337. 3p. (UCSD—891004). NTIS, PC A02/MF A01; 1; GPO Dep. Order Number DE88013872/JAW.

The fate of organic matter in the sea, whether produced in situ or introduced from land, is greatly influenced by the metabolic trophic activities of the resident biota. Until recently it was thought that much of the primary production is consumed by the herbivores, making them the main determinants of fate of organic matter. It now appears that the microbial component of marine foodweb also plays a significant role in the decomposition, distribution, and vertical flux of organic material in seawater. The goal of the proposed research is to quantify this role of the microbial foodweb as part of a DOE-sponsored interdisciplinary study. We are testing the hypothesis that organic matter utilization by heterotrophic bacterioplankton represents a major sink for organic matter in the Southern California Coastal Zone.

47436 **(DOE/ER/60341—1) [A proposal to measure the density and nutrient fields at openings to a marine basin and to model the fluxes within the basin]: [Progress report].** Jackson, G.A. (Scripps Institution of Oceanography, San Diego, CA (USA)). Jun 1986. Contract FG05-85ER60341. 4p. (UCSD—861485). NTIS, PC A02/MF A01; GPO Dep. Order Number DE88013870/JAW.

This project is part of the multi-investigator, multi-disciplinary West Coast Program to study the carbon flux in marine basins (California Basin Study-CaBs). My role, and that of my group, in this program is to integrate various results using computer models. For a variety of reasons, my role has also evolved to include measuring the distributions of dissolved oxygen, nutrients, total organic nitrogen (TON), and total organic carbon (TOC), coordinating the ship scheduling and coordinating sampling with the California Cooperative Fisheries Investigation (CalCOFI) program. During the last year, my group has developed one-dimensional models to describe the fat of organic matter in the SMSP Basin. These models presently assumes rates of organic matter consumption to infer rates of physical processes, such as mixing between basins and non-basin waters. The information developed in the DOE program should provide measured rates of organic matter transformation and deposition which can be used to calculate the physical mixing rates. These values can be compared with values to be obtained as part of the current measurements made in this program.

47437 **(DOE/ER/60341—3) A proposal to measure the density and nutrient fields at openings to a marine basin and to model the fluxes within the basin: [Progress report, June 1987-June 1988].** (Scripps Institution of Oceanography, San Diego, CA (USA)). 1988. Contract FG05-85ER60341. 4p. (UCSD—891005). NTIS, PC A02/MF A01; GPO Dep. Order Number DE88013871/JAW.

This program is directed at describing and understanding the origin, transport, and fate of organic matter in the marine basins off Southern California. Individual projects are focused on describing different aspects of organic matter cycling, ranging from measurements of the primary production that forms much of the organic matter source, measurements of vertical particles fluxes, measurements of zooplankton feeding and excretion, measurements of bacterial degradation of this organic matter, elucidation of organic matter transformation in the sediments, and description of the physical processes that move organic matter. Besides its marine production, organic matter is also added to the ocean as a result of human activities. Because the region being studied, the combined Santa Monica-San Pedro Basins (SMSP), is relatively isolated from the surrounding ocean by submarine mountain ranges, these processes affect the concentrations of various elements in the SMSP water column. The effect is most dramatic in the low oxygen concentrations below the sill at 740 m but exists for other elements throughout the water column.

47438 **(UCRL—98872) Hydrogeology and hydrodynamics of coral reef pore waters.** Buddemeier, R.W.; Oberdorfer, J.A. (Lawrence Livermore National Lab., CA (USA)). 29 Jun 1988. Contract W-7405-ENG-48. 6p. (CONF-880873—2). NTIS, PC A02. Order Number DE88014144/JAW.

From 6. international coral reef symposium; Townsville, Australia (8 Aug 1988).

A wide variety of forces can produce head gradients that drive the flow and advective mixing of internal coral reef pore waters. Oscillatory gradients that produce mixing result from wave and tide action. Sustained gradients result from wave and tide-induced setup and ponding, from currents impinging on the reef structure, from groundwater heads, and from density differenced (temperature or salinity gradients). These gradients and the permeabilities and porosities of reef sediments are such that most macropore environments are dominated by advection rather than diffusion. The various driving forces must be analyzed to determine the individual and combined magnitudes of their effects on a specific reef pore-water system. Pore-water movement controls sediment diagenesis, the exchange of nutrients between sediments and benthos, and coastal/island groundwater resources. Because of the complexity of forcing functions, their interactions with specific local reef environments, experimental studies require careful incor-

poration of these considerations into their design and interpretation. 8 refs., 3 figs., 1 tab.

64 PHYSICS I

6401 Astrophysics And Cosmology

REFER ALSO TO CITATION(S) 47591

47439 **(BROWN/HET—644) Inflation, cosmic strings, and galaxy formation.** Brandenberger, R.H. (Brown Univ., Providence, RI (USA). Dept. of Physics). Nov 1987. Contract AC02-76ER03130. 6p. (CONF-871286—1). NTIS, PC A02. Order Number DE88008629/JAW.

From International conference on gravitation and cosmology; Goa, India (14 Dec 1987).

Inflationary universe models and the cosmic string theory provide two district ways to explain the origin of inhomogeneities in the universe on large scales. I shall summarize and compare the two mechanisms for the origin of galaxies and clusters of galaxies, and mention some recent results on galaxy formation with hot dark matter and cosmic stings. 28 refs., 6 figs.

47440 **(LA-UR—88-1741) Particle physics candidates for the cosmion solution to the solar neutrino problem.** Raby, S. (Los Alamos National Lab., NM (USA)). 1988. Contract W-7405-ENG-36. 18p. (CONF-8803109—6). NTIS, PC A03/MF A01; 1; GPO Dep. Order Number DE88014479/JAW.

From 23. Rencontre de Moriond conference: electroweak interactions and unified theories; Les Arcs, France (6 Mar 1988).

This paper discuss several particle physics candidates for the cosmic solution to the solar neutrino problem. Some of these candidates are: Cold dark matter; No conserved particle number; Conserved particle number but No cosmic asymmetry; and Conserved particle number and a cosmic asymmetry. Also outlined are their properties and methods of detecting them. 23 refs., 8 figs. (LSP)

47441 **(LA-UR—88-1878) Cosmogenic {sup 36}Cl production rates in meteorites and the lunar surface.** Nishiizumi, K.; Kubik, P.W.; Elmore, D.; Reedy, R.C.; Arnold, J.R. (Los Alamos National Lab., NM (USA)). 1988. Contract W-7405-ENG-36;W-31109-ENG-38. 30p. (CONF-880391—2). NTIS, PC A03/MF A01; 1; GPO Dep. Order Number DE88014452/JAW.

From GEOTIMES: 19th lunar and planetary science conference; Houston, TX, USA (14 Mar 1988).

Activity-versus-depth profiles of cosmic-ray-produced {sup 36}Cl were measured in metal from two cores each in the St. Severin and Jilin chondrites and in lunar core 15008. Production of {sup 36}Cl in these samples range from high-energy reactions with Fe and Ni to low-energy reactions with Ca and K and possibly neutron-capture reactions with {sup 35}Cl. The cross sections used in the Reedy-Arnold model for neutron-induced reactions were adjusted to get production rates that fit the measured {sup 36}Cl activities in St. Severin metal and in the lunar soil of core 15008. The {sup 36}Cl in metal from St. Severin has a fairly flat activity-versus-depth profile, unlike most other cosmogenic nuclides in bulk samples from St. Severin, which increase in concentration with depth. In metal from Jilin, a decrease in {sup 36}Cl was observed near its center. The length of Jilin's most recent cosmic-ray exposure was {approximately}0.5 My. Lunar core 15008 has an excess in {sup 36}Cl of about 4 dpm/kg near its surface that was produced by solar-proton-induced reactions. The calculated production rates are consistent with these measured trends in 15008. 39 refs., 4 figs., 3 tabs.

47442 **(LBL—25212) The dialogue between particle physics and cosmology.** Sadoulet, B. (Lawrence Berkeley Lab., CA (USA)). Apr 1988. Contract AC03-76SF00098. 92p. (CONF-870821—15). NTIS, PC A05. Order Number DE88014684/JAW.

From SLAC summer institute on particle physics: looking beyond the Z; Stanford, CA, USA (10 Aug 1987).

In the last decade, a very close relationship has developed between particle physics and cosmology. The purpose of these lectures is to introduce particle physicists to the many scientific connections between the two fields. Before entering into the discussion of specific topics, it will first be shown that particle physics and cosmology are completely interdependent. 173 refs., 35 figs., 5 tabs.

47443 **(N—88-22966) Impact-induced devolatilization and hydrogen isotopic fractionation of serpentine: implications for planetary accretion.** Tyburczy, J.A.; Krishnamurthy, R.V.; Epstein, S.; Ahrens, T.J. (Arizona State Univ., Tempe (USA)). 1988. 36p. (NASA-CR—182877; NAS—1.26:182877). NTIS, PC A03/MF A01.

Impact-induced devolatilization of porous serpentine was investigated using two independent experimental methods, the gas recovery and the solid recovery method, each yielding nearly identical results. For shock pressures near incipient devolatilization, the hydrogen isotopic composition of the evolved H_2O is very close to that of the starting material. For shock pressures at which up to 12 percent impact-induced devolatilization occurs, the bulk evolved gas is significantly lower in deuterium than the starting material. There is also significant reduction of H_2O to H_2 in gases recovered at these higher shock pressures, probably caused by reaction of evolved H_2O with the metal gas recovery fixture. Gaseous H_2O-H_2 isotopic fractionation suggests high temperature isotopic equilibrium between the gaseous species, indicating initiation of devolatilization at sites of greater than average energy deposition. Bulk gas-residual solid isotopic fractionations indicate nonequilibrium, kinetic control of gas-solid isotopic ratios. Impact-induced hydrogen isotopic fractionation of hydrous silicates during accretion can strongly affect the long-term planetary isotopic ratios of planetary bodies, leaving the interiors enriched in deuterium. Depending on the model used for extrapolation of the isotopic fractionation to devolatilization fractions greater than those investigated experimentally can result from this process.

47444 **Model-independent constraints on possible modifications of Newtonian gravity.** Talmadge, C.; Berthias, J.; Hellings, R.W.; Standish, E.M. (Physics Department, Purdue University, West Lafayette, Indiana 479071). *Physical Review Letters;* **61**: No. 10, 1159-1162(5 Sep 1988).

New model-independent constraints on possible modifications of Newtonian gravity over solar-system distance scales are presented and their implications discussed. The constraints arise from the analysis of various planetary astrometric data sets. The results of the model-independent analysis are then applied to set limits on a variation in the $1/r^2$ behavior of gravity, on possible Yukawa-type interactions with ranges of the order of planetary distance scales, and on a deviation from Newtonian gravity of the type discussed by Milgrom.

47445 **Neutral-current reactions of solar and supernova neutrinos on deuterium.** Bahcall, J.N.; Kubodera, K.; Nozawa, S. (Institute for Advanced Study, Princeton, New Jersey 08540). *Physical Review* [*Section*] *D: Particles and Fields;* **38**: No. 4, 1030-1039(15 Aug 1988).

We calculate the cross sections for the neutral-current disintegration of deuterium by neutrinos and antineutrinos: $\nu+d\rightarrow\nu'+n+p$ and nu-bar$+d\rightarrow$nu-bar$'+n+p$. We put special emphasis on estimates of the theoretical uncertainties of these cross sections. For ^8B and hep solar neutrinos, the averaged cross sections are $\langle\sigma(^8B)\rangle = 4.1(1 +- 0.1) \times 10/sup -43/ cm^2$ and $\langle\sigma(hep)\rangle = 1.15(1 +- 0.1) \times 10/sup -42/ cm^2$, respectively, where hep denotes ^3He+p. The cross-section uncertainty is negligible, +- 1/2%, for the ratio of neutral-current to charged-current events. Independent of neutrino oscillations, the cross sections correspond to $4.5(1 +- 0.38) \times 10^5$ solar-neutrino events per year in the proposed one-kiloton Sudbury Neutrino Observatory if the standard solar model is correct. For a galactic supernova, the total number of neutral-current events expected in the Sudbury detector is about 10^3 (distance/8 kpc)/sup -2/; most of the signal is expected to arise from μ and tau neutrinos and antineutrinos. If either μ or tau neutrinos have a mass greater than 2×10^2 eV, then this mass should be measurable using the neutrino signal from a galactic supernova.

47446 **Inhomogeneous nucleosynthesis with neutron diffusion.** Kurki-Suonio, H.; Matzner, R.A.; Centrella, J.M.; Rothman, T.; Wilson, J.R. (Department of Physics and Atmospheric Science, Drexel University, Philadelphia, Pennsylvania 19104). *Physical Review* [*Section*] *D: Particles and Fields;* **38**: No. 4, 1091-1099(15 Aug 1988).

It was recently proposed that a critical, i.e., closure, baryon density could be compatible with helium and deuterium observations, if this baryon density were suitably inhomogeneous during cosmic nucleosynthesis. In this scenario, neutrons would diffuse out of the high-density regions, which would lead to a nonstandard nucleosynthesis, with reduced helium production and improved deuterium survival, and could restore the agreement with observations, which is lost in homogeneous closure models. We have used a numerical model which shows that this proposal is not viable. Our model combines inhomogeneous nucleosynthesis and neutron diffusion self-consistently to study element formation in inhomogeneous situations in which diffusion is important. We find that the proposal fails: it is very difficult to lower the helium production significantly or to raise the final deuterium abundance, because the neutrons diffuse back to the high-density region once nucleosynthesis begins there.

47447 **Are cosmic strings frustrated?.** Hill, C.T.; Kagan, A.L.; Widrow, L.M. (Fermi National Accelerator Laboratory, P.O. Box 500, Batavia, Illinois 60510). *Physical Review* [*Section*] *D: Particles and Fields;* **38**: No. 4, 1100-1107(15 Aug 1988).

In models involving more than one U(1)'-charged scalar field (as is often the case in grand unified theories) the cosmic strings which emerge may be more complicated than simple Nielsen-Olesen flux tubes. In particular, strings can form with domain walls or with log-infinite contributions to the mass. A universe with these strings is very different from one in which there are only Nielsen-Olesen-type flux tubes.

47448 **Quantum probability distributions in the early Universe. I. Equilibrium properties of the Wigner equation.** Graziani, F.R. (School of Physics and Astronomy, University of Minnesota, Minneapolis, Minnesota 55455). *Physical Review* [*Section*] *D: Particles and Fields;* **38**: No. 4, 1122-1130(15 Aug 1988).

This is the first in a series of papers dealing with quantum or Wigner probability distributions and the dynamics of early-Universe phase transitions. In this paper we argue that the inflaton field (a real gauge-singlet scalar field) when spatially averaged over a causal horizon behaves as if it were a dissipative quantum-mechanical system in one dimension. Realizing that the mathematical phase-space or stochastic description of Wigner is the only consistent way to describe these systems and still preserve the canonical commutation relations we devote this paper to investigating various properties of the Wigner formalism. This framework rests on the quasiprobability distribution and its evolution equation: a generalized Fokker-Planck equation. We first show that this generalized Fokker-Planck equation is equivalent to Schroedinger's equation for nondissipative pure states. We then show how one computes ground-state energies within this formalism (for nondissipative systems) by calculating ground-state energy levels for a variety of anharmonic potentials. Finally we compute the quantum-mechanical effective potential in one dimension to order $g(h/2\pi)$.

47449 **Calculations of rates for direct detection of neutralino dark matter.** Griest, K. (Astronomy and Astrophysics Center, Enrico Fermi Institute, The University of Chicago, Chicago, Illinois 60637). *Physical Review Letters;* **61**: No. 6, 666-669(8 Aug 1988).

The detection rates in cryogenic detectors of neutralinos, the most well motivated supersymmetric dark-matter candidate, are calculated. These rates can differ greatly from the special cases of pure photoinos and pure Higgsinos which are usually considered. In addition, a new term is found in the elastic-scattering cross section proportional to the Z-ino component which is "spin independent," even for these Majorana particles. As a result, substantial detection rates exist for previously disfavored, mostly spinless materials such as germanium and mercury.

47450 **Laboratory limits on galactic cold dark matter.** Caldwell, D.O.; Eisberg, R.M.; Grumm, D.M.; Witherell, M.S.; Sadoulet, B.; Goulding, F.S.; Smith, A.R. (Department of Physics, University of California, Santa Barbara, California 93106). *Physical Review Letters;* **61**: No. 5, 510-513(1 Aug 1988).

Interesting limits are set on candidates for cold-dark-matter particles in the halo of our Galaxy from their interaction with a very-low-background Ge detector used to search for double β decay. Dirac neutrinos constituting all of dark matter are excluded for masses between 12 GeV/c^2 and 1.4 TeV/c^2. There are slightly better limits on magninos and cosmions, proposed massive particles which also explain the solar-neutrino problem but which interact more strongly with Ge. In addition, millicharged shadow matter is ruled out as the main form of dark matter.

47451 **Angular momentum, hierarchical clustering, and local density maxima.** Hoffman, Y. (Los Alamos National Lab., NM (USA)). *Astrophysical Journal;* **329**: 8-15(Jun 1988).

The growth of angular momentum in a hierarchical clustering cosmogony is studied to first order in linear theory. Structure is assumed to evolve from a primordial Gaussian density perturbation (delta) field. The protoobjects are identified with the local peaks of the primordial delta-field. Ensembles of such objects are constructed, and both mean values and the scatter around them are calculated. This is done by realizing Gaussian delta-fields for different power spectra, identifying the local peaks of such fields, and calculating the tidal deformation and inertial tensors of the peaks. Linear theory is then used to calculate the final J and lambda. The calculations support the view that a hierarchical clustering process yields an anticorrelation of lambda versus v (or the final density) of bound objects. 22 references.

47452 **Positron annihilation radiation from the Galactic center - Cheshire cat' Compton scattering and the origin of excess continuum.** Bildsten, L.; Zurek, W.H. (Cornell Univ., Ithaca, NY (USA); Los Alamos National Lab., NM (USA)). *Astrophysical Journal;* **329**: 212-224(Jun 1988).

Two observations of the gamma-ray spectrum from the direction of the Galactic center were made by HEAO 3 in the fall of 1979 and the spring of 1980. The 2-gamma 511 keV annihilation line flux decreased by a factor of about three during the 6 months between these observations, while the excess gamma-ray continuum below the annihilation line, often interpreted as 3-gamma decay of orthopositronium, barely changed. This discrepancy in temporal behavior makes the identification of the bulk of excess continuum as 3-gamma decay of positronium difficult. It is shown that Compton scattering of the line and high-energy radiation provides a natural explanation for the surprisingly small changes seen in the excess continuum. Scattered photons are delayed by a time corresponding to the size of the scattering region. For the annihilation source in the Galactic center, this distance is probably a fraction of a parsec. Thus, even after the high-energy continuum and annihilation line are gone, low-energy Compton-scattered photons can still be detected with an almost unchanged flux. 23 references.

6402 Atmospheric Physics

REFER ALSO TO CITATION(S) 47514

47453 **Structure of relativistic magnetosonic shocks in electron-positron plasmas.** Langdon, A.B.; Arons, J.; Max, C.E. (Institute of Geophysics and Planetary Physics and Physics Department, Lawrence Livermore National Laboratory, University of California, Livermore, California 94550). *Physical Review Letters;* **61**: No. 7, 779-782(15 Aug 1988).

The one-dimensional structure of high—Mach-number, transverse magnetosonic relativistic shocks is studied computationally by kinetic, particle-in-cell methods. For amplitudes of astrophysical interest, shocks are mediated by magnetic reflection of the incoming plasma stream. The resulting coherent Larmor loops at the shock front are unstable, and rapidly thermalize downstream to form a

relativistic, quasi-Maxwellian plasma in the momenta normal to the background magnetic field.

6403 Atomic, Molecular, And Chemical Physics

REFER ALSO TO CITATION(S) 46463, 47078, 47513, 47696

47454 **(CONF-880779—1) Vacuum sorption pumping at cryogenic temperatures of argon and oxygen on molecular sieves.** Perona, J.J.; Gibson, M.R.; Byers, C.H. (Oak Ridge National Lab., TN (USA)). 1988. Contract AC05-84OR21400. 23p. NTIS, PC A03/MF A01; 1; GPO Dep. Order Number DE88013840/JAW.

From NATO ASI on adsorption; Vimeiro, Portugal (17 Jul 1988).

Cryosorption pumping is a method of excavating enclosed volumes by adsorbing gas on a deep bed of solid sorbent (typically a zeolite) at cryogenic temperatures. Modeling the dynamic behavior of these systems for air pumping requires information on two major constituents of air, oxygen and argon, which had not been previously studied, as well as data on a nonadsorbing specie, helium. Deep beds of Davison 4A molecular sieves were subjected to a metered flow of pure gas and the pressure history of the experiment was monitored, using computer data acquisition techniques. Particle size variations is the major variable in determining the mechanism of the process. The data acquired in the current study compare favorably with previous experiments. Previously developed models for the dynamic sorption behavior of deep beds under vacuum for two extreme conditions, micropore and micropore control were tested in this study. The sorption behavior of argon clearly fit into the category of macropore controlled sorption, indicating that these species are adsorbed primarily on the surface of the zeolite crystals, much like the theoretical and experimental results for N_2 cryosorption on the same sieves of Crabb. On the other hand oxygen sorption is most likely micropore controlled, and may be molded by the method of Praznick. 11 refs., 7 figs., 1 tab.

47455 **(DOE/ER/53205—T3) [Atomic processes in high temperature plasmas]: Progress report.** (Connecticut Univ., Storrs (USA)). 1988. Contract FG02-85ER53205. 5p. NTIS, PC A02/MF A01; 1; GPO Dep. Order Number DE88013005/JAW.

It is proposed to continue the theoretical study of dielectronic recombination (DR) and related resonant processes in electron-ion collisions, with special emphasis on the effect of high temperature plasma environment. The DR work on the B-like ions, improvement of the empirical rate formula, and the static field effect on high Rydberg states will continue. A theoretical procedure will be developed to incorporate the effects of both the static ion microfield and time-dependent electron density of the plasma. In addition, the resonant ionization process will be examined to understand the recent experimental observations. This includes both the cascade Auger decay and simultaneous two-electron emission of the resonant states. Improved electron correlation is needed.

47456 **(DOE/ER/60473—1) Selective excitation, relaxation and energy channeling in molecular systems: Progress report, February 1, 1987-July 1, 1988.** Rhodes, W.C. (Florida State Univ., Tallahassee (USA). Inst. of Molecular Biophysics). 1988. Contract FG05-86ER60473. 9p. NTIS, PC A02/MF A01; 1; GPO Dep. Order Number DE88014727/JAW.

This research program involves the theory of dynamical properties of complex molecular systems having many kinds of degrees of freedom and heterogeneous molecular structure. A general feature is how the dynamics of one subsystem are modulated by interactions with the remaining subsystems. Such modulation affects the response, relaxation, and the channeling of processes in the system as a whole. Quantum mechanical coherence and correlation among the components of this system underlie most of the effects encountered. Specific topics discussed are: coherent energy migration in helical polypeptides; squeezed states of light; and nonequilibrium thermodynamics. 2 figs.

47457 **(IC—88/40) Divergence treatment in calculating molecular force constants and normal vibrations.** Wang Kelin; Hu Fengming; Cheng Jafu. (International Centre for Theoretical Physics, Trieste (Italy); China Univ. of Science and Technology, Hefei, AH. Center of Fundamental Physics). (International Centre for Theoretical Physics, Trieste (Italy)). Feb 1988. 10p. NTIS (US Sales Only), PC A02/MF A01. Order Number DE88703840/JAW.

Divergence difficulties may arise while calculating molecular force constants and normal vibrations by least-squares method with computers. Here we give a new method to remove the difficulties. Satisfying results are obtained when we apply it to a water molecule. (author). 10 refs, 3 tabs.

47458 **(INIS-BR—1157, pp 36) Intermediate valence and thermodynamic perturbation.** Foglio, M.E. (Universidade Estadual de Campinas (Brazil). Inst. de Fisica). 1981. NTIS (US Sales Only), PC A06/MF A01. Order Number DE88703560/JAW. (CONF-8109291—).

From 7. Latin American symposium on solid state physics; Gramado, Brazil (14 Sep 1981).

47459 **(INIS-BR—1157, pp 40) Tm/sub x/Se: an inhomogeneous intermediate valence system.** Mazzaferro, J.; Alascio, B. (Comision Nacional de Energia Atomica, San Carlos de Bariloche (Argentina). Centro Atomico Bariloche). 1981. (In Spanish). NTIS (US Sales Only), PC A06/MF A01. Order Number DE88703560/JAW. (CONF-8109291—).

From 7. Latin American symposium on solid state physics; Gramado, Brazil (14 Sep 1981).

47460 **(INIS-BR—1157, pp 41) Spin variation theory in thulium compounds.** Mazzaferro, J.; Balseiro, C.A.; Alascio, B. (Comision Nacional de Energia Atomica, San Carlos de Bariloche (Argentina). Centro Atomico Bariloche). 1981. (In Spanish). NTIS (US Sales Only), PC A06/MF A01. Order Number DE88703560/JAW. (CONF-8109291—).

From 7. Latin American symposium on solid state physics; Gramado, Brazil (14 Sep 1981).

47461 **(INIS-BR—1164, pp 52) Two-dimension dipolar system a molecular dynamics study.** Hornos, Y.M.M.; Hipolito, O. (Sao Paulo Univ., Sao Carlos, SP (Brazil). Inst. de Fisica e Quimica). 1987. NTIS (US Sales Only), PC A09/MF A01. Order Number DE88703566/JAW. (CONF-8705181—).

From 10. national meeting on condensed matter physics; Caxambu, Brazil (5 May 1987).

47462 **(INIS-BR—1164, pp 55) Quasi-two-dimensional electrons: finite width effects of the electronic shell.** Rino, J.P.; Studart, N. (Sao Carlos Univ. (Brazil)). 1987. (In Portuguese). NTIS (US Sales Only), PC A09/MF A01. Order Number DE88703566/JAW. (CONF-8705181—).

From 10. national meeting on condensed matter physics; Caxambu, Brazil (5 May 1987).

47463 **(INIS-BR—1164, pp 66) Renormalization group studies applied to adsorbed systems.** Massunaga, M.S.O.; Mello, E.V.L. (Rio de Janeiro Univ. (Brazil). Inst. de Fisica; Universidade Federal Fluminense, Niteroi (Brazil). Inst. de Fisica). 1987. (In Portuguese). NTIS (US Sales Only), PC A09/MF A01. Order Number DE88703566/JAW. (CONF-8705181—).

From 10. national meeting on condensed matter physics; Caxambu, Brazil (5 May 1987).

47464 **(INIS-BR—1164, pp 69) Kondo lattice study.** Brunnet, L.G.; Teixeira, R.M.R.; Iglesias-Sicardi, J.R. (Rio Grande do Sul Univ., Porto Alegre (Brazil)). 1987. NTIS (US Sales Only), PC A09/MF A01. Order Number DE88703566/JAW. (CONF-8705181—).

From 10. national meeting on condensed matter physics; Caxambu, Brazil (5 May 1987).

47465 (INIS-BR—1164, pp 109) **Green functions for intermediate valence lattices.** Martinez, G.; Foglio, M.E. (Universidade Estadual de Campinas (Brazil). Inst. de Fisica). 1987. (In Portuguese). NTIS (US Sales Only), PC A09/MF A01. Order Number DE88703566/JAW. (CONF-8705181—).

From 10. national meeting on condensed matter physics; Caxambu, Brazil (5 May 1987).

47466 (INIS-BR—1164, pp 110) **Photoemission in the Anderson-Falicov Model.** Frota, H.O. da. (Amazonas Univ., Manaus (Brazil)). 1987. (In Portuguese). NTIS (US Sales Only), PC A09/MF A01. Order Number DE88703566/JAW. (CONF-8705181—).

From 10. national meeting on condensed matter physics; Caxambu, Brazil (5 May 1987).

47467 (INIS-BR—1164, pp 110) **Deep level photoemission in fluctuating valence compounds.** Yoshida, M.; Frota, H.O. da. (Amazonas Univ., Manaus (Brazil)). 1987. (In Portuguese). NTIS (US Sales Only), PC A09/MF A01. Order Number DE88703566/JAW. (CONF-8705181—).

From 10. national meeting on condensed matter physics; Caxambu, Brazil (5 May 1987).

47468 (INIS-BR—1164, pp 12) **Optimization by annealing in atomic physics: an unified description of light atoms below the multiple ionization threshold.** Hornos, J.E.M. (Sao Paulo Univ., Sao Carlos, SP (Brazil). Inst. de Fisica e Quimica). 1987. NTIS (US Sales Only), PC A09/MF A01. Order Number DE88703566/JAW. (CONF-8705181—).

From 10. national meeting on condensed matter physics; Caxambu, Brazil (5 May 1987).

47469 (INIS-BR—1164, pp 14) **Resonant Raman spectroscopy.** Cunha, S.L.S. (Rio Grande do Sul Univ., Porto Alegre (Brazil). Inst. de Fisica). 1987. (In Portuguese). NTIS (US Sales Only), PC A09/MF A01. Order Number DE88703566/JAW. (CONF-8705181—).

From 10. national meeting on condensed matter physics; Caxambu, Brazil (5 May 1987).

47470 (INIS-BR—1164, pp 17) **Wave function for the Helium isoelectronic series.** Fontenele, M.; Gallas, J.A.C. (Santa Catarina Univ., Florianopolis (Brazil). Dept. de Fisica). 1987. (In Portuguese). NTIS (US Sales Only), PC A09/MF A01. Order Number DE88703566/JAW. (CONF-8705181—).

From 10. national meeting on condensed matter physics; Caxambu, Brazil (5 May 1987).

47471 (INIS-BR—1164, pp 17) **Quadratic Zeeman effect in hydrogen.** Rech, P.C.; Gallas, J.A.C. (Universidade para o Desenvolvimento do Estado de Santa Catarina, Joinville (Brazil). Dept. de Ciencias Exatas; Santa Catarina Univ., Florianopolis (Brazil). Dept. de Fisica). 1987. (In Portuguese). NTIS (US Sales Only), PC A09/MF A01. Order Number DE88703566/JAW. (CONF-8705181—).

From 10. national meeting on condensed matter physics; Caxambu, Brazil (5 May 1987).

47472 (INIS-BR—1164, pp 18) **Simplified LMR.** Ferrari, C.A.; Sosman, L.P. (Universidade Estadual de Campinas (Brazil). Inst. de Fisica). 1987. (In Portuguese). NTIS (US Sales Only), PC A09/MF A01. Order Number DE88703566/JAW. (CONF-8705181—).

From 10. national meeting on condensed matter physics; Caxambu, Brazil (5 May 1987).

47473 (INIS-BR—1164, pp 32) **Study of the Pd-hydrogen system by EXAFS.** Cardoso, L.P.; Pick, M. (Universidade Estadual de Campinas (Brazil). Inst. de Fisica; Brookhaven National Lab., Upton, NY (USA)). 1987. (In Portuguese). NTIS (US Sales Only), PC A09/MF A01. Order Number DE88703566/JAW. (CONF-8705181—).

From 10. national meeting on condensed matter physics; Caxambu, Brazil (5 May 1987).

47474 (INIS-BR—1164, pp 126) **Temperature effett on the process of radiative transition broadening in f orbitals of Eu/sup ++/ as ionic crystals defect.** Lopes, G.N.; Castro Neto, J.C. (Sao Paulo Univ., Sao Carlos, SP (Brazil). Inst. de Fisica e Quimica). 1987. (In Portuguese). NTIS (US Sales Only), PC A09/MF A01. Order Number DE88703566/JAW. (CONF-8705181—).

From 10. national meeting on condensed matter physics; Caxambu, Brazil (5 May 1987).

47475 (INIS-BR—1164, pp 129) **X-ray absorption in atoms submitted to intense fields of lasers in the Seely-Harris approximation.** Fonseca, A.L.A.; Oliveira, A.C.N. (Brasilia Univ. (Brazil). Dept. de Fisica). 1987. (In Portuguese). NTIS (US Sales Only), PC A09/MF A01. Order Number DE88703566/JAW. (CONF-8705181—).

From 10. national meeting on condensed matter physics; Caxambu, Brazil (5 May 1987).

47476 (INIS-BR—1164, pp 9) **Inelastic scattering of electrons by magnesium atoms: 3/sup 1/p and 3/sup 3/p excitation study.** Pagan, C.J.B.; Meneses, G.D.; Machado, L.E. (Universidade Estadual de Campinas (Brazil). Inst. de Fisica; Sao Carlos Univ. (Brazil)). 1987. (In Portuguese). NTIS (US Sales Only), PC A09/MF A01. Order Number DE88703566/JAW. (CONF-8705181—).

From 10. national meeting on condensed matter physics; Caxambu, Brazil (5 May 1987).

47477 (INIS-BR—1164, pp 9) **Low energy electron scattering by polyatomic molecules.** Tavares, P.F.; Brescansin, L.M.; Machado, L.E.; Lima, M.A.P. (Universidade Estadual de Campinas (Brazil); Sao Carlos Univ. (Brazil); Centro Tecnico Aeroespacial, Sao Jose dos Campos (Brazil). Inst. de Estudos Avancados). 1987. (In Portuguese). NTIS (US Sales Only), PC A09/MF A01. Order Number DE88703566/JAW. (CONF-8705181—).

From 10. national meeting on condensed matter physics; Caxambu, Brazil (5 May 1987).

47478 (INIS-BR—1164, pp 9) **Spin effects in electron-photon coincidence experiment.** Paixao, F.J. da. (Universidade Estadual de Campinas (Brazil). Inst. de Fisica). 1987. (In Portuguese). NTIS (US Sales Only), PC A09/MF A01. Order Number DE88703566/JAW. (CONF-8705181—).

From 10. national meeting on condensed matter physics; Caxambu, Brazil (5 May 1987).

47479 (INIS-BR—1164, pp 10) **Polyatomic molecule photoionization.** Miranda, E.; Brescansin, L.M.; Machado, L.E.; Lima, M.A.P. (Universidade Estadual de Campinas (Brazil); Sao Carlos Univ. (Brazil); Centro Tecnico Aeroespacial, Sao Jose dos Campos (Brazil). Inst. de Estudos Avancados). 1987. (In Portuguese). NTIS (US Sales Only), PC A09/MF A01. Order Number DE88703566/JAW. (CONF-8705181—).

From 10. national meeting on condensed matter physics; Caxambu, Brazil (5 May 1987).

47480 (INIS-BR—1164, pp 10) **Spin polarization in the inelastic scattering of electrons by atoms: the spin orbit effect in the 3/sup 1/S -> 3/sup 3/P/sub 0,1,2/ transitions of the neon atom.** Ferraz, M.C.C.; Machado, L.E.; Leal, E.P.; Meneses, G.D. (Sao Paulo Univ., Sao Carlos, SP (Brazil). Inst. de Fisica e Quimica; Sao Carlos Univ. (Brazil). Dept. de Fisica; Universidade Estadual de Campinas (Brazil). Inst. de Fisica). 1987. (In Portuguese). NTIS (US Sales Only), PC A09/MF A01. Order Number DE88703566/JAW. (CONF-8705181—).

From 10. national meeting on condensed matter physics; Caxambu, Brazil (5 May 1987).

47481 (INIS-BR—1164, pp 10) **High and low number simulation in the computer program.** Pagan, C.J.B. (Universidade Estadual de Campinas (Brazil). Inst. de Fisica). 1987. (In Portuguese). NTIS (US Sales Only), PC A09/MF A01. Order Number DE88703566/JAW. (CONF-8705181—).

From 10. national meeting on condensed matter physics; Caxambu, Brazil (5 May 1987).

47482 (INIS-BR—1164, pp 12) **Alignement in resonant photoionization of helium atoms.** Hornos, J.E.M. (Sao Paulo Univ., Sao Carlos, SP (Brazil). Inst. de Fisica e Quimica). 1987. NTIS (US Sales Only), PC A09/MF A01. Order Number DE88703566/JAW. (CONF-8705181—).

From 10. national meeting on condensed matter physics; Caxambu, Brazil (5 May 1987).

47483 (INIS-BR—1164, pp 17) **Intense magnetic field effect in the interaction between hydrogen and anti-hydrogen.** Gallas, J.A.C. (Santa Catarina Univ., Florianopolis (Brazil). Dept. de Fisica). 1987. (In Portuguese). NTIS (US Sales Only), PC A09/MF A01. Order Number DE88703566/JAW. (CONF-8705181—).

From 10. national meeting on condensed matter physics; Caxambu, Brazil (5 May 1987).

47484 (INIS-BR—1164, pp 13) **Factors which influenciate the growth of the Stokes second component in a Raman cell.** Pacheco, M.T. (Centro Tecnico Aeroespacial, Sao Jose dos Campos (Brazil). Inst. de Estudos Avancados). 1987. (In Portuguese). NTIS (US Sales Only), PC A09/MF A01. Order Number DE88703566/JAW. (CONF-8705181—).

From 10. national meeting on condensed matter physics; Caxambu, Brazil (5 May 1987).

47485 (INIS-BR—1164, pp 13) **1.5 μm radiation generation with high conversion efficiency.** Pacheco, M.T. (Centro Tecnico Aeroespacial, Sao Jose dos Campos (Brazil). Inst. de Estudos Avancados). 1987. (In Portuguese). NTIS (US Sales Only), PC A09/MF A01. Order Number DE88703566/JAW. (CONF-8705181—).

From 10. national meeting on condensed matter physics; Caxambu, Brazil (5 May 1987).

47486 (INIS-BR—1164, pp 15) **Inhibition of the SF/sub 6/ cluster formation in supersonic expansion.** Airoldi, V.J.T.; Corat, E.J.; Sbampato, M.E.; Santos, A.M. dos; Ghizoni, C.C. (Centro Tecnico Aeroespacial, Sao Jose dos Campos (Brazil). Inst. de Estudos Avancados; Instituto de Pesquisas Espaciais, Sao Jose dos Campos (Brazil)). 1987. (In Portuguese). NTIS (US Sales Only), PC A09/MF A01. Order Number DE88703566/JAW. (CONF-8705181—).

From 10. national meeting on condensed matter physics; Caxambu, Brazil (5 May 1987).

47487 (INIS-BR—1164, pp 79) **Lithography by electron beam controlled by computer.** Paciornik, S.; Nunes, R.A.; Galucio, E.G.; Carmo, L.C.S. do. (Pontificia Univ. Catolica do Rio de Janeiro (Brazil)). 1987. (In Portuguese). NTIS (US Sales Only), PC A09/MF A01. Order Number DE88703566/JAW. (CONF-8705181—).

From 10. national meeting on condensed matter physics; Caxambu, Brazil (5 May 1987).

47488 (INIS-BR—1164, pp 78) **Construction of an acoustic-optical modulator for Q-switching.** Rossi, W. de; Nogueira, G.E.C.; Morato, S.P.; Vieira Junior, N.D. (Instituto de Pesquisas Energeticas e Nucleares, Sao Paulo (Brazil)). 1987. (In Portuguese). NTIS (US Sales Only), PC A09/MF A01. Order Number DE88703566/JAW. (CONF-8705181—).

From 10. national meeting on condensed matter physics; Caxambu, Brazil (5 May 1987).

47489 (ITEP—136(1987)) **Coulomb systems distorted at short distances in atomic and nuclear physics.** Popov, V.S. (Gosudarstvennyj Komitet po Ispol'zovaniyu Atomnoj Ehnergii SSSR, Moscow. Inst. Teoreticheskoj i Ehksperimental'noj Fiziki). 1987. 42p. NTIS (US Sales Only), PC A03/MF A01. Order Number DE88703615/JAW.

In systems bound by the Coulomb interaction distorted at short distances there may appear, under certain conditions, a rearrangment of atomic spectrum (or the Zel'dovich effect). Specific features of this effect are discussed for states with an arbitrary angular momentum l (both with and without the absorption). The equation is studied which connects nuclear level shifts with the low-energy scattering parameters a/sub l/, r/sub l/. The conditions have been found under which the rearrangement of spectrum is replaced by oscillations of atomic levels. The Coulomb renormalization of scattering lengths and that of effective ranges is discussed. Some manifestations of the Zel'dovich effect in the physics of hadronic atoms and mesomolecules are considered. 49 refs.; 9 figs.

47490 (LA-UR—88-1748) **Pressure broadening of the [(dtμ)dee]/sup */ formation resonances.** Cohen, J.S.; Leon, M.; Padial, N.T. (Los Alamos National Lab., NM (USA)). 1988. Contract W-7405-ENG-36. 14p. (CONF-8805170—3). NTIS, PC A03/MF A01; 1; GPO Dep. Order Number DE88014475/JAW.

From Muon catalyzed fusion workshop; Sanibel Island, FL, USA (2 May 1988).

The treatment of [(dtμ)dee]/sup */ formation at high densities as a pressure broadening process is discussed. The quasistatic approximation is shown to satisfy the usual conditions of muon-catalyzed fusion better than does the impact approximation. Complete accurate results are shown for the impact approximation, and a preliminary rough treatment is presented to illustrate the quasistatic approximation. 13 refs., 8 figs.

47491 (LA-UR—88-2188) **High energy-intensity atomic oxygen beam source for low earth orbit materials degradation studies.** Cross, J.B.; Blais, N.C. (Los Alamos National Lab., NM (USA)). 1988. Contract W-7405-ENG-36. 14p. (CONF-880781—1). NTIS, PC A03/MF A01; 1; GPO Dep. Order Number DE88014316/JAW.

From 16. international symposium on rarefied gas dynamics; Pasadena, CA, USA (11 Jul 1988).

A high intensity (10^{19}O-atoms/s-sr) high energy (5 eV) source of oxygen atoms has been developed that produces a total fluence of 10^{22} O-atoms/cm^2 in less than 100 hours of continuous operation at a distance of 15 cm from the source. The source employs a CW CO_2 laser sustained discharge to form a high temperature (15,000 K) plasma in the throat of a 0.3-mm diameter nozzle using 3–8 atmospheres of rare gas/O_2 mixtures. Visible and infrared photon flux levels of 1 watt/cm^2 have been measured 15 cm downstream of the source while vacuum UV (VUV) fluxes are comparable to that measured in low earth orbit. The reactions of atomic oxygen with kapton, Teflon, silver, and various coatings have been studied. The oxidation of kapton (reaction efficiency = 3 {times} 10/sup {minus}24/ cm {+-} 50%) has an activation energy of 0.8 Kcal/mole over the temperature range of 25{degree}C to 100{degree}C at a beam energy of 1.5 eV and produces low molecular weight gas phase reaction products (H_2O, NO, CO_2). Teflon reacts with ~0.1–0.2 efficiency to that of kapton at 25{degree}C and both surfaces show a rug-like texture after exposure to the O-atom beam. Angular scattering distribution measurements of O-atoms show a near cosine distribution from reactive surfaces indicating complete accommodation of the translational energy with the surface while a nonreactive surface (nickel oxide) shows specular-like scattering with 50% accommodation of the translational energy with the surface. A technique for simple on orbit chemical experiments using resistance measurements of coated silver strips is described. 9 figs.

47492 (UCRL—98918) Dissociative recombination of H{sub 2}{sup +} and H{sub 3}{sup +} ions on surfaces. Hiskes, J.R.; Karo, A.M. (Lawrence Livermore National Lab., CA (USA)). 27 May 1988. Contract W-7405-ENG-48. 18p. (CONF-8805162—1). NTIS, PC A03/MF A01; 1; GPO Dep. Order Number DE88013104/JAW.

From International symposium on dissociative recombinations, theory, experiment and applications; Alberta, Canada (28 May 1988).

A four-step model for recombination and dissociative recombination H{sub 2}{sup +} and H{sub 3}{sup +} ions on metal surfaces is discussed. The model results for H{sub 2}{sup +} are consistent with available experimental data. Vibrationally excited molecules from H{sub 3}{sup +} recombination are produced in a broad spectrum that enhances the excited level distribution. The application of this latter process to hydrogen negative ion discharge is discussed. 24 refs., 5 figs., 2 tabs.

47493 One- and two-color multiphoton ionization of argon. Li, L.; Wu, M.; Johnson, P.M. (Department of Chemistry, State University of New York at Stony Brook, Stony Brook, New York 11794-3400). *Journal of Chemical Physics;* **89**: No. 6, 3470-3478(15 Sep 1988).

A systematic explanation of the pressure-dependent multiphoton ionization spectra of argon is given in terms of the phase matching requirements of third-harmonic generation. Two-color sum-frequency generation in a highly dispersive medium and its effects on normal three-photon excitation process are analyzed, using argon as an example. Finally an anomaly in the resonance line shapes of the two laser MPI spectra of argon is reported and attributed to the displacement of the foci of the two counterpropagating laser beams.

47494 Shape-resonance-induced non-Franck—Condon effects in (2+1) resonance enhanced multiphoton ionization of the C ^{3}Pi/sub g/ state of O_2. Stephens, J.A.; Braunstein, M.; McKoy, V. (Arthur Amos Noyes Laboratory of Chemical Physics, California Institute of Technology, Pasadena, California 91125). *Journal of Chemical Physics;* **89**: No. 6, 3923-3925(15 Sep 1988).

We show that strong non-Franck—Condon effects observed in (2+1) resonance enhanced multiphoton ionization of the C ^{3}Pi/sub g/ state of O_2 are due to the kσ/sub u/ shape resonance previously observed in single-photon studies of diatomic molecules. Calculated vibrational branching ratios for the v′ = 2,3 levels of the C ^{3}Pi/sub g/ state are in reasonable agreement with experiment. Certain discrepancies remain in comparing theoretical results with the measured spectra, and possible electron-correlation effects which underly this are discussed.

47495 Dynamics of electron impact dissociative excitation of XeF_2: Production of XeF (B, v′, N′). Spence, D.; Dillon, M.A. (Argonne National Laboratory, Argonne, Illinois 60439). *Journal of Chemical Physics;* **89**: No. 6, 3596-3601(15 Sep 1988).

By using high-resolution electron beam techniques, we demonstrate that production of XeF(B) by electron impact dissociative excitation of XeF_2 occurs via the XeF_2 $^1\Sigma^+$/sub u/ excited state. Furthermore, measurements of the fluorescence yield from the transitions XeF(B,v′, N′→X, v″, N″) in the range 325—360 nm, combined with published Franck—Condon factors for these transitions, show that dissociative excitation of XeF_2 produces XeF(B) that is vibrationally hot but rotationally cool. Relative vibrational populations of XeF(B, v′, N′) are derived.

47496 Observations of two-electron—jump, core-changing x-ray transitions in fluorinelike and oxygenlike lanthanum. Chandler, G.A.; Dietrich, D.D.; Chen, M.H.; Fortner, R.J.; Hailey, C.J.; Stewart, R.E. (University of California, Lawrence Livermore National Laboratory, Livermore, California 94550). *Physical Review Letters;* **61**: No. 10, 1186-1189(5 Sep 1988).

We have observed in high-Z ions, electric dipole allowed, two-electron—jump, core-changing transitions in fluorinelike and oxygenlike lanthanum. X-ray transitions between the upper 2s^{2}2p/sup n/3p excited levels and the lower 2s2p/sup n//sup +2/ hole states of oxygenlike and fluorinelike lanthanum are reported. These transitions are particularly interesting as a test of the theoretical atomic physics calculations as well as a possible plasma density diagnostic.

47497 Vibrational predissociation dynamics of $ArCl_2$: Intramolecular vibrational relaxation in a triatomic van der Waals molecule?. Evard, D.D.; Bieler, C.R.; Cline, J.I.; Sivakumar, N.; Janda, K.C. (Department of Chemistry, University of Pittsburgh, Pittsburgh, Pennsylvania 15260). *Journal of Chemical Physics;* **89**: No. 5, 2829-2838(1 Sep 1988).

Rotational—vibrational distributions are reported for Cl_2 product states of the vibrational predissociation of the v = 6 through v = 12 levels of the $ArCl_2$ molecule in the B electronic state. For v = 6 and 7, the Δv = -1 dissociation channel dominates the predissociation dynamics, and the observed rotational distribution appears to be slightly inverted. This inversion does not appear to be due to "momentum gap" constraints but may be due to kinematic symmetry selection rules. Above v = 7 the molecule decays via the Δv = -2 channel. Unlike the rotational distributions observed for $HeCl_2$ and $NeCl_2$, those of the $ArCl_2$ Δv = -2 channel are highly structured and have a strong dependence on the initially excited vibrational level. It is argued that the dependence of the observed rotational distribution on the initial vibrational state (for the dissociation of $ArCl_2$) is due to intermediate resonances in a sequential, IVR mechanism, whereas the dissociation of $HeCl_2$ and $NeCl_2$ occurs by a direct mechanism. Although this conclusion cannot be proved at this time, experiments and calculations are suggested that would directly measure the participation of intermediate levels.

47498 Observation of the formation of C^+, O^+, and ArC^+ in the collisions of Ar^+ (^{2}P/sub 3/2,1/2/) with CO. Flesch, G.D.; Ng, C.Y. (Ames Laboratory-U.S. Department of Energy and Department of Chemistry, Iowa State University, Ames, Iowa 50011). *Journal of Chemical Physics;* **89**: No. 5, 3381-3382(1 Sep 1988).

Absolute total cross sections for the formation of C^+, O^+, and ArC^+ in the collisions of Ar^+ (^{2} P/sub 3/2,1/2/)+CO have been measured over the center-of-mass collision energy (E/sub c.m./) range of ~4—123 eV. The observed appearance energies for C^+ and O^+ are in agreement with the thermochemical thresholds for the C^+ (^{2} P)+$O(^3$ P) and O^+ (^{4} S^0)+$C(^3$ P) product channels, respectively. The cross sections for C^+ are significant compared to those for CO^+. At E/sub c.m./ = 12.9 eV, the analysis of the kinetic energy distributions of C^+ and CO^+ supports the conclusions that many excited vibronic states of CO^+ are populated and that the C^+ ions are formed by predissociation of electronic excited CO^+.

47499 Reply to a "Comment on: 'The vibrational relaxation of highly excited molecules' ". Gordon, R.J.; Beck, K.M. (Department of Chemistry, University of Illinois at Chicago, Chicago, Illinois 60680). *Journal of Chemical Physics;* **89**: No. 5, 3399-3400(1 Sep 1988).

Lenzi et al's comments on the number of photons absorbed by sulfur hexafluoride, and the subsequent transfer of energy to argon atoms are answered. It is suggested that the optoacoustic and the IR absorption measurements should be complimentary to each other.(AIP)

47500 Electron collision excitations in complex spectra of ionized heavy atoms. Bar-Shalom, A.; Klapisch, M.; Oreg, J. (Nuclear Research Centre—Negev, P.O.Box 9001, 84chemical bond105 Beer-Sheva, Israel). *Physical Review [Section] A: General Physics;* **38**: No. 4, 1773-1784(15 Aug 1988).

A theory for calculating a many-transition spectrum of electron-ion collisional excitations in the distorted-wave approximation (DWA) is presented. First, it is shown that the collision strength including exchange can be factorized into (i) a radial part, involving one-electron wave functions only, and the summation over partial waves of the continuum electron; and (ii) an angular part, involving the coupling between bound electrons in the target states only, specific to each transition. Factorized representations of the collision strengths are derived in various coupling schemes. Second, the computationally involved radial part is shown to be a smooth

function of transition energies over a very wide range, allowing easy interpolation. These two results enable one to obtain a complete collisional-excitation array with a drastic reduction of the number of time-consuming radial calculations compared with standard methods. This allows the solution of problems which were heretofore considered impractical. As an illustration, the whole array of excitation rate coefficients for Ni-like Gd XXXVII including the lowest 107 levels (5671 transitions) was calculated in the DWA, and used in a steady-state collisional-radiative model. Resulting population inversions are presented versus plasma density.

47501 **Incident-energy dependence of electron-ion collision cross sections.** Kim, Y.; Desclaux, J. (National Bureau of Standards, Gaithersburg, Maryland 20899). *Physical Review [Section] A: General Physics;* **38**: No. 4, 1805-1808(15 Aug 1988).

It is shown that the dependence of electron-impact cross sections σ for the excitation of ions on the incident energy T can be represented by compact expressions for a wide range of T from thresholds to 10 keV. These expressions are $\sigma T = A \ln T + B + C/T + D \ln T/T$ for dipole- and spin-allowed transitions, $\sigma T = A + B/T + C/T^2 + D/T^3$ for dipole-forbidden but spin-allowed transitions, and $\sigma T = (A + BT)/(1 + CT + DT^2)$ for spin-forbidden transitions, where A, B, C, and D are constants that depend on target properties but not on T. These formulas should provide accurate cross sections in applications where many atomic cross sections are needed. Examples are presented for the excitations of Be-like Fe/sup +22/ ion by electron impact.

47502 **Interference effects in electron-ion recombination. II. Resonance and direct channels.** LaGattuta, K.J. (Los Alamos National Laboratory (Mail Stop B-257), University of California, Los Alamos, New Mexico 87545). *Physical Review [Section] A: General Physics;* **38**: No. 4, 1820-1830(15 Aug 1988).

The Feshbach formalism is employed in a study of the effects of interference between direct radiative recombination and dielectronic recombination. A general result is obtained, valid for an arbitrary number of interacting resonances and an arbitrary number of coupled continua. The results of explicit model calculations, based on the pole approximation, are described, and comparison is made with earlier, related work.

47503 **Intermediate-velocity atomic collisions. III. Electron capture in 8.6- MeV/amu Ca ions.** Montenegro, E.C.; Xu, X.; Meyerhof, W.E.; Anholt, R.; Danzmann, K.; Schlachter, A.S.; Rude, B.S.; McDonald, R.J. (Department of Physics, Stanford University, Stanford, California 94305-4060). *Physical Review [Section] A: General Physics;* **38**: No. 4, 1854-1859(15 Aug 1988).

Electron-capture cross sections by 8.6-MeV/amu Ca/sup 18+/, Ca/sup 19+/, and Ca/sup 20+/ beams were measured in gas targets from H_2 to Xe. Measurements were made of total electron capture as well as of electron capture in coincidence with projectile K x rays. Comparison with the eikonal approximation shows a reasonable agreement with the experimental data. The effect of various metastable states of the heliumlike Ca/sup 18+/ ion created by electron capture for Ca/sup 19+/ projectiles is analyzed, showing that these states play an important role in the detected x-ray yields.

47504 **Analysis of electron correlation in simultaneous electron transfer and excitation in atomic collisions.** Fritsch, W.; Lin, C.D. (Department of Physics, Rice University, Houston, Texas 77251 and Bereich Physik, Hahn-Meitner-Institut Berlin, D-1000 Berlin 39, West Germany). *Physical Review Letters;* **61**: No. 6, 690-693(8 Aug 1988).

The two-electron process of simultaneous electron transfer and excitation (TE) in atomic collisions is studied within the close-coupling method for the example of the system $He^+ + H$. The calculated energy dependence of the population of various helium doubly excited states is analyzed for the role of electron correlations in the resonant and nonresonant contributions to the TE process which are included coherently. It is predicted that the impact-parameter—dependent state-selective TE probabilities for this process show conspicuous peak structures.

47505 **Stability and observability of charged beryllium clusters.** Khanna, S.N.; Reuse, F.; Buttet, J. (Physics Department, Virginia Commonwealth University, Richmond, Virginia 23284-2000). *Physical Review Letters;* **61**: No. 5, 535-538(1 Aug 1988).

Electronic structure studies on neutral, singly and doubly charged Be/sub n/ clusters ($n \leqq 5$) have been carried out within the local spin-density formalism. We present results on their equilibrium geometries and atomization energies and discuss the stability of charged clusters. An extensive study of the Born-Oppenheimer surface of Be trimers is given and it is shown that small doubly charged clusters may exist in metastable states protected from dissociation by large energy barriers. The possibility of creating them by one- or two-step ionization processes critically depends on their geometries. We also address the issue of charge localization in doubly charged clusters.

47506 **Direct measurement of counterion distribution around cylindrical micelles by small-angle x-ray scattering.** Wu, C.F.; Chen, S.H.; Shih, L.B.; Lin, J.S. (Department of Nuclear Engineering and Center for Materials Science etts Engineering, Massachusetts Institute of Technology, Cambridge, Massachusetts 02139). *Physical Review Letters;* **61**: No. 5, 645-648(1 Aug 1988).

The small-angle x-ray scattering technique was applied to measure the distribution of Cs^+ counterions around the surface of cylindrical micelles. The scattering intensity distribution was compared with that calculated by use of the analytical solutions of a nonlinear Poisson-Boltzmann (PB) equation in a cell model. Quantitative agreement was obtained for the cases without added salt. The addition of other monovalent salts did not modify the counterion distribution significantly in accordance with the prediction of the numerical solution of the PB equation.

6404 Fluid Physics

REFER ALSO TO CITATION(S) 47869

47507 (INIS-BR—1164, pp 65) **Dipolar complexes in liquid helium films.** Cavalcante, M.G.; Degani, M.H.; Hipolito, O. (Sao Paulo Univ., Sao Carlos, SP (Brazil). Inst. de Fisica e Quimica). 1987. (In Portuguese). NTIS (US Sales Only), PC A09/MF A01. Order Number DE88703566/JAW. (CONF-8705181—).

From 10. national meeting on condensed matter physics; Caxambu, Brazil (5 May 1987).

47508 (INIS-BR—1164, pp 150) **Fluid flux effects in magnetic resonance.** Leite, V.B.P.; Bonagamba, T.J.; Tannus, A.; Panepucci, H.C.; Magon, C.J.; Schmidt, M.A. (Sao Paulo Univ., Sao Carlos, SP (Brazil). Inst. de Fisica e Quimica). 1987. (In Portuguese). NTIS (US Sales Only), PC A09/MF A01. Order Number DE88703566/JAW. (CONF-8705181—).

From 10. national meeting on condensed matter physics; Caxambu, Brazil (5 May 1987).

47509 **(UCRL—98977) Application of a second-order projection method to the study of shear layers.** Bell, J.B.; Glaz, H.M.; Solomon, J.M.; Szymczak, W.G. (Lawrence Livermore National Lab., CA (USA)). Jun 1988. Contract W-7405-ENG-48. 7p. (CONF-8806125—2). NTIS, PC A02/MF A01; 1; GPO Dep. Order Number DE88013095/JAW.

From 11. international conference on numerical methods in fluid dynamics; Williamsburg, VA, USA (27 Jun 1988).

In this paper we apply a second-order projection method for the time-dependent, incompressible Navier-Stokes equations to the study of shear layers. The algorithm represents a higher-order extension of Chorin's projection algorithm. In Chorin's algorithm one first solves the Navier-Stokes equations ignoring the pressure term and then projects the resulting velocity field onto discretely divergence-free vector fields. Our method introduces more coupling between the diffusion-convection step and the projection to obtain second-order temporal accuracy. Furthermore, the algorithm incor-

porates a second-order Godunov method that provides a robust treatment of the nonlinear terms at high Reynolds number. These features combine to give a method that is second-order accurate for smooth flows and remains stable for singular initial data such as cortex sheets, even in the limit of vanishing viscosity. 9 refs., 2 figs.

47510 **Temporal evolution of collisionless sheaths.** Cho, M.H.; Hershkowitz, N.; Intrator, T. (Department of Nuclear Engineering and Engineering Physics, University of Wisconsin, Madison, Wisconsin 53706). *Journal of Vacuum Science and Technology, A: Vacuum, Surfaces, and Films;* 6: No. 5, 2978-2986(Sep 1988).

We have performed experimental measurements to determine the temporal evolution of Langmuir sheaths near an electrode to which a negative step bias is applied in a collisionless argon plasma. The plasma was produced by a hot-filament discharge in a multidipole device. Plasma potential data were obtained using emissive probes with two different techniques: time resolved sampling and time averaged techniques. The sheath is found to initially form close to the electrode, to extend to a maximum separation, and to contract to a steady-state value. The time scale required to reach a steady state is close to the time scale of the presheath relaxation. Characteristics of sheaths in rf plasmas are also measured using a parallel-plate plasma capacitor. It is observed that the plasma potential profile has significant variation with frequency, even for frequencies as low as 1 kHz which are far below the ion plasma frequency (~1 MHz).

47511 **Depression of nonlinearity in decaying isotropic turbulence.** Kraichnan, R.H.; Panda, R. (303 Potrillo Drive, Los Alamos, New Mexico 87544). *Physics of Fluids;* 31: No. 9, 2395-2397(Sep 1988).

Simulations of decaying isotropic Navier—Stokes turbulence exhibit depression of the normalized mean-square nonlinear term to 57% of the value for a Gaussianly distributed velocity field with the same instantaneous velocity spectrum. Similar depression is found for dynamical models with random coupling coefficients (modified Betchov models). This suggests that the depression is dynamically generic rather than specifically driven by alignment of velocity and vorticity.

47512 **Pattern competition in temporally modulated Rayleigh-Benard convection.** Meyer, C.W.; Cannell, D.S.; Ahlers, G.; Swift, J.B.; Hohenberg, P.C. (Department of Physics, University of California, Santa Barbara, California 93106). *Physical Review Letters;* 61: No. 8, 947-950(22 Aug 1988).

Shadowgraph flow-visualization studies and heat-flux measurements were used to study convection subjected to temporal modulation of the Rayleigh number R in the form $\epsilon(t) = R(t)/R_c = \epsilon_0 + \delta \sin(\omega t)$, where R_c is the unmodulated threshold, and ω and t are scaled by the vertical thermal diffusion time. For $\omega = 15$ and 0.7approx. $< \delta$approx. < 2.0 the predicted hexagonal patterns were observed for a range of ϵ_0 immediately above the convective threshold ϵ_c. With increasing ϵ_0 there is a region exhibiting coexistence between hexagons and rolls, followed by roll-like patterns. The observed boundaries between these regions and the magnitude of the convective heat transport are consistent with theory.

47513 **Observable fast kinetic eigenmode in binary noble-gas mixtures?.** Campa, A.; Cohen, E.G.D. (The Rockefeller University, New York, New York 10021). *Physical Review Letters;* 61: No. 7, 853-856(15 Aug 1988).

It is suggested that a fast kinetic mode should be observable in a whole class of disparate mass fluid mixtures, such as gaseous He-Xe, by neutron scattering experiments, at not too high densities and Xe concentrations.

47514 **New regimes of magnetic reconnection in collisionless plasmas.** Hewett, D.W.; Francis, G.E.; Max, C.E. (Physics Department and Institute of Geophysics and Planetary Physics, Lawrence Livermore National Laboratory, University of California, Livermore, California 94550). *Physical Review Letters;* 61: No. 7, 893-896(15 Aug 1988).

An implicit particle-in-cell code has been used to study collisionless magnetic reconnection of a current sheet. The reconnection process is found to occur in three distinct stages: (1) early spontaneous reconnection fed by the free energy of an initial anisotropy in the electron component, (2) coalescence of the resulting small-scale filaments of electron current, accompanied by electron jetting; and (3) oscillatory flow of electrons through the magnetic X point, superposed on continuing nonlinear growth of ion-mediated reconnection. The time evolution of stage 3 is strongly dependent on M_i/m_e.

6450 High Energy Physics

REFER ALSO TO CITATION(S) 47442

47515 **(DOE/ER/03230—T7) Research in elementary particle physics: Technical progress report, June 1, 1987-May 31, 1988.** Kirsch, L.E.; Schnitzer, H.J.; Abbott, L.F.; Bensinger, J.R.; Blocker, C.A. (Brandeis Univ., Waltham, MA (USA). Dept. of Physics). 1988. Contract AC02-76ER03230. 10p. NTIS, PC A03/MF A01; 1; GPO Dep. Order Number DE88013801/JAW.

The main topics discussed in the progress report: electron/photon algorithm groups; W and Z analysis; heavy quark analysis; gas gain monitoring; database upgrade; CDF test beam studies; string theory; cosmology; and neutral networks. (LSP)

6451 Particle Interactions And Properties - Experimental

REFER ALSO TO CITATION(S) 47449, 47450, 47575, 47609

47516 **(BNL—41396) Light meson spectroscopy: The D(1285) [f_1 (1285)] and E/iota(1420) [f_1 (1420), {eta} (1440)].** Birman, A.; Chung, S.U.; Fernow, R.; Kirk, H.; Peaslee, D.; Protopopescu, S.; Weygand, D.; Willutzki, H.; Boehnlein, A.; Boehnlein, D.; Goldman, J.H.; Hagopian, V.; Reeves, D.; Blessing, S.; Crittenden, R.; Dzierba, A.; Marshal, T.; Teige, S.; Zieminska, D.; Bar-Yam, Z.; Dowd, J.; Kern, W.; King, E.; Rudnicka, H.; Rulon, P. (Brookhaven National Lab., Upton, NY (USA); Florida State Univ., Tallahassee (USA); Indiana Univ., Bloomington (USA); Southeastern Massachusetts Univ., North Dartmouth (USA)). 1988. Contract AC02-76CH00016. 12p. (CONF-8803108—). NTIS, PC A03/MF A01; 1; GPO Dep. Order Number DE88013678/JAW.

From Workshop on production and decay of light mesons; Paris, France (3 Mar 1988).

The $K^+K^0\pi^-$ state has been produced by π^-,K^- and {bar char}p beams at beam momenta of about 8 GeV/c. The π^- and {bar char}p beam data show peaks at 1285 and 1420 MeV identified as the D(12185) and E/iota(1420). The K^- beam data does not show any $K^+K^0\pi^-$ peaks. A partial wave analysis of the π^- beam data show evidence of $J^{PG} = 1^{++}$ resonance at 1285 MeV together with a small 0^{-+} peak. The 1420 MeV peak is mainly a 0^- +/resonance with a small amount of 1^{++}. There is an indication of a 1^{+-} state at 1420 MeV. Also observed is a peak at a mass of 1512 MeV. 6 refs., 7 figs.

47517 **(BNL—41506) A search for effective flavour changing neutral currents in K_L^0 decays.** Mannelli, M.; Greenlee, H.B.; Kasha, H.; Mannelli, E.B.; Schaffner, S.F.; Schmidt, M.P.; Adair, R.K.; Jastrzembski, E.; Larsen, R.C.; Leipuner, L.B. (Brookhaven National Lab., Upton, NY (USA)). 1988. Contract AC02-76CH00016;AC02-76ER03075. 12p. (CONF-8803109—5). NTIS, PC A03/MF A01; 1; GPO Dep. Order Number DE88013766/JAW.

From 23. Rencontre de Moriond conference: electroweak interactions and unified theories; Les Arcs, France (6 Mar 1988).

A dedicated search for the decays $K_L^0 \to \mu e$, $K_L^0 \to ee$ and $K_L^0 \to \mu\mu$, was carried out at the Brookhaven National Laboratory AGS (E780). The data obtained were also used in a search for the three-body decays $K_L^0 \to \pi^0 l^+ l^-$ ($l = e, \mu$). The two body modes were normalized to the kinelatically similar, CP violating, decay K_L^0

{yields} {pi}{sup (plus)}{pi}{sup {minus}}; whereas the three body modes were normalized to the decay K{sub L}{sup 0} {yields} {pi}{sup 0}{pi}{sup {plus}{pi}{sup {minus}}. The search was performed on a sample of K{sup 0} mesons produced in the forward direction by the interactions of 29 GeV protons on a copper target, and decaying in a 3 meter long region, starting augmented by a hydrogen Cerenkov counter and a lead glass electromagnetic calorimeter, for electron identification, and by a range stack, for muon identification. 9 refs., 5 figs., 2 tabs.

47518 **(CERN/EP—83-135) Latest results from the UA2 experiment at the CERN {bar p}p Collider: W → eν, Z^0 → e/sup {pluse}/e/sup {minus}/ hadron jets.** Sauvage, G.; Schacher, J. (European Organization for Nuclear Research, Geneva (Switzerland)). 9 Sep 1983. 33p. (CONF-830718—40). NTIS (US Sales Only), PC A03; 1; GPO Dep. Order Number DE88012581/JAW.

From International Europhysics conference on high energy physics; Brighton, UK (20 Jul 1983).

We report preliminary results of searches for high p/sub T/ single electrons and for high p/sub T/ electron pairs in the UA2 experiment at the CERN {bar p}p Collider. 35 single electrons associatd with events with large missing transverse momentum are measured, and are compatible with {bar p}p → W/sup {plus}/ X and W → eν; eight observed high p/sub T/ electron pairs, with invariant masses around 90 GeV/c^2, are interpretd as resulting from {bar p}p → Z^0 {plus} X with Z^0 → e/sup {plus}/e/sup {minus}/ (γ). We then deacribe the production and the properties of high transvers momentum hadron jets. The cross sections for inclusive jet production and for two-jet masses of up to 270 GeV/c^2 are presented. 25 refs., 23 figs.

47519 **(CERN-EP—88-25) The production of J/{Psi} in 200 GeV/A oxygen-uranium interactions.** Abreu, M.C.; Alimi, M.; Baglin, C.; Baldit, A.; Barreira, G.P.; Bedjidian, M.; Bordalo, P.; Borenstein, S.; Britz, J.; Bussiere, A.; Busson, P.; Casaca, A.; Cases, R.; Castor, J.; Charlot, C.; Chaurand, B.; Contardo, D.; Descroix, E.; Devaux, A.; Fargeix, J.; Felgeyrolles, X.; Force, P.; Fredj, L.; Gago, J.M.; Gerschel, C.; Gomes, P.; Gorodetzky, P.; Grossiord, J.Y.; Guichard, A.; Guillaud, J.P.; Haroutunian, R.; Kluberg, L.; Kraus, L.; Landaud, G.; Linck, I.; Lourenco, C.; Maio, A.; Peralta, L.; Pimenta, M.; Pizzi, J.R.; Racca, C.; Ramos, S.; Romana, A.; Salmeron, R.; Sinquin, A.; Sonderegger, P.; Varela, J. (European Organization for Nuclear Research, Geneva (Switzerland)). 29 Feb 1988. 18p. (CONF-8708202—11). NTIS (US Sales Only), PC A03; 1; GPO Dep. Order Number DE88012613/JAW.

From Quark matter '87: 6th international conference on ultra-relativistic nucleus-nucleus collisions; Schloss Nordkirchen, F.R. Germany (24 Aug 1987).

The dimuon production in 200 GeV/nucleon oxygen-uranium interactions is studied by the NA38 Collaboration. The production of J/{Psi}, correlated with the transverse energy E/sub T/ is investigated and compared to the continuum, as a function of the dimuon mass M and transverse momentum P/sub T/. A value of 0.64 +- 0.06 is found for the ratio ({Psi}/Continuum at high E/sub T/)/({Psi}/Continuum at low E/sub T/, from which the J/{Psi} relative suppression can be extracted. This suppression is enhanced at low P/sub T/. 6 refs., 11 figs., 2 tabs.

47520 **(CERN/EP—88-63) The heavy quark effort in the CERN fixed target programme.** Rossi, L. (European Organization for Nuclear Research, Geneva (Switzerland)). 7 Jun 1988. 39p. (CONF-880288—3). NTIS (US Sales Only), PC A03; 1; GPO Dep. Order Number DE88013862/JAW.

From Les Recontres de Physique; La Thuile, Italy (28 Feb 1988).

The experimental effort devoted to the study of heavy quarks in the CERN fixed target programme is reviewed. Emphasis is given to the most recent results and to the perspectives of the new generation of CERN experiments. 27 refs., 27 figs.

47521 **(DOE/ER/01195—T9) Hadroproduction of Λ/sub c/ → pKπ.** Filaseta, J.E. (Illinois Univ., Urbana (USA). Graduate Coll.). 1987. Contract AC02-76ER01195. 143p. NTIS, PC A07/MF A01; 1; GPO Dep. Order Number DE88014946/JAW.

Production of the charmed baryon Λ/sub c/ has been observed in n-nucleus collisons at the Proton East area of FNAL. A 5σ peak was seen in the decay mode Λ/sub c//sup {plus}/ → pK/sup {minus}/π/sup {plus}/ (and charged congugate). The lifetime was determined to be consistent with the current world average of 0.23 ps, and the cross section for Λ/sub c/$^+$ at $\sqrt{s}$ = 33 GeV was measured to be σ {center←dot} BR = 2.1 +- 1.1 (+-.74)μb/nucleon for 0.028 < x/sub f/ < 0.226. The fraction of Λ/sub c/$^+$/(Λ/sub c/$^+$ + Λ/sub c//sup {minus}) was estimated to be 78% {plus←minus} 18%. 40 refs.

47522 **(GSI—88-18-Prepr.) Sensitive search for neutral resonances around 1.8 MeV/c/sup 2/ in Bhabha scattering.** Tsertos, H.; Kozhuharov, C.; Armbruster, P.; Kienle, P.; Krusche, B.; Schreckenbach, K. (Gesellschaft fuer Schwerionenforschung m.b.H., Darmstadt (Germany, F.R.); Institut Max von Laue - Paul Langevin, 38 - Grenoble (France)). (Gesellschaft fuer Schwerionenforschung m.b.H., Darmstadt (Germany, F.R.); Institut Laue-Langevin, 38 - Grenoble (France)). Mar 1988. 12p. Gesellschaft fuer Schwerionenforschung m.b.H., Darmstadt (Germany, F.R.).

The excitation function for Bhabha scattering was measured in the energy range between 760 and 840 keV (c.m.) in 1.4 keV steps with beams of monochromatic positrons scattered on a Be foil at angles between 79/sup 0/ and 101/sup 0/ (c.m.). The statistical accuracy was 0.5%. Up to an upper limit of 0.75 b.eV/sr (c.m.) for the energy-integrated differential cross section (97% C.L.) no resonant scattering was observed. This limit corresponds to a maximal resonance contribution of 1% relatively to the Bhabha cross section, consistent with the upper bound, derived from precision measurements of the electron (g-2) factor.

47523 **(LA-UR—88-1957) Summary of neutrino presentations.** White, D.H. (Los Alamos National Lab., NM (USA)). 1988. Contract W-7405-ENG-36. 12p. (CONF-8805142—10). NTIS, PC A03/MF A01; 1; GPO Dep. Order Number DE88014441/JAW.

From 3. international conference on the intersections between particle and nuclear physics; Rockport, ME, USA (14 May 1988).

This summary is divided into two sections. First, we concentrate on conventional neutrino physics interpreted in the context of standard electroweak theory. Second, we discuss double beta decay where gross violations of the predictions of the theory might appear, and also we discuss specific searches for consequences of finite neutrino mass. 11 figs., 5 tabs.

47524 **(LBL—25425) pp, pA and αα collisions and the understanding of the quark-gluon plasma.** Geist, W.M. (Lawrence Berkeley Lab., CA (USA)). Jun 1988. Contract AC03-76SF00098. 14p. (CONF-8803109—4). NTIS, PC A03/MF A01; 1; GPO Dep. Order Number DE88013711/JAW.

From 23. Rencontre de Moriond conference: electroweak interactions and unified theories; Les Arcs, France (6 Mar 1988).

Global characteristics of heavy ion collisions at high energy are now understood at some level such that the challenging search for Quark-Gluon plasma signatures becomes of more importance. Some features of pp, pA, and α{ alpha} interactions at $\sqrt{s} \leq 62$ GeV are selected to illustrate potential consequences for, and problems of, investigations of the Quark-Gluon plasma. 35 refs., 8 figs.

47525 **(LBL—25475) Dielectron production in p+Be and Ca+Ca collisions at the Bevalac.** Roche, G.; Krebs, G.F.; Lallier, E.; Letessier-Selvon, A.; Matis, H.S.; Naudet, C.; Schroeder, L.; Seidl, P.A.; Yegneswaran, A.; Bystricky, J.; Carroll, J.; Gordon, J.; Igo, G.; Hallman, T.; Madansky, L.; Welsh, R.; Kirk, P.; Wang, Z.F.; Miller, D.; Landaud, G. (Lawrence Berkeley Lab., CA (USA); California Univ., Los Angeles (USA); Johns Hopkins Univ., Baltimore, MD (USA); Louisiana State Univ., Baton Rouge (USA); Northwestern Univ., Evanston, IL (USA); Clermont-Ferrand-2 Univ., 63 - Aubiere (France)). Jun 1988. Contract AC03-76SF00098. 6p. (CONF-8806117—7). NTIS, PC A02/MF A01; 1; GPO Dep. Order Number DE88013714/JAW.

From 3. international conference on nucieus nucleus collisions; Saint-Malo, France (6 Jun 1988).

Dielectron production has been measured in p+Be collisions at 1.0, 2.1 and 4.9 GeV, and in Ca+Ca at 1.0 and 2.0 GeV/A. The observation of a structure in the mass cross section at about two times the pion mass suggests that pion annihilation is the dominant production mechanism in p+Be above 2 GeV. Comparison of preliminary results from p+Be and Ca+Ca at 1 GeV/A is presented. 7 refs., 5 figs., 1 tab.

47526 **(LBL—25532) Radiative widths of resonances (experiments).** Gidal, G. (Lawrence Berkeley Lab., CA (USA)). Jul 1988. Contract AC03-76SF00098. 22p. (CONF-8804147—4). NTIS, PC A03/MF A01; 1; GPO Dep. Order Number DE88014660/JAW.

From 8. international workshop on photon-photon collisions; Shoresh, Israel (24 Apr 1988).

After a hiatus of several years, this conference brings us considerable new data on resonance production in photon photon interactions. I will first discuss the contributions concerning the tensor, pseudoscalar and scalar mesons, then review the current status of the (c{ovr string}c {eta}/sub c/) and finally summarize the exciting new results concerning the spin 1 mesons. 40 refs., 21 figs., 7 tabs.

47527 **(NIKHEF-H—87-22) Rise of the proton-(anti)proton total cross section at tevatron energies and beyond.** Kluit, P.M.; Timmermans, J. (Nationaal Inst. voor Kernfysica en Hoge-Energiefysica (NIKHEF), Amsterdam (Netherlands). Sectie H). Dec 1987. 17p. NTIS (US Sales Only), PC A03/MF A01. Order Number DE88703936/JAW.

A dispersion relation analysis of the UA4 result on the real part of the panti p elastic scattering amplitude is presented. The interpretation is twofold. Assuming that the pp and panti p cross sections are asymptotically identical, a steep rise is deduced of the total cross section in the 1-4 TeV domain. In case the pp and panti p cross sections are asymptotically different, it is deduced that there is a crossing of the total cross section of pp and panti p between ISR and Spanti pS energies followed by a steep rise of the difference of the pp and panti p total cross sections. It is shown that in both cases this rise can be accounted for if we add an additional term with an energy cut-off to the usual Amaldi parametrisation of the total cross section: ln/sup 2/(s/s/sub cut/) in the first case, or ln(s/s/sub cuto/) in the second case, where √s/sub cut/ lies around 500 GeV and √s/sub cuto/ around 63 GeV. Both quantities can be interpreted as a threshold of a new process. For the first case, a continuous parametrisation without a threshold is also proposed with an extra term of the form ln/sup 2/(1+ s/s/sub 1/), where √s/sub 1/ equals 700 GeV. 12 refs.; 5 figs.; 3 tabs.

47528 **(NIKHEF-H—88-2) Photon gluon fusion cross sections at HERA energy.** Engelen, J.J.; Jong, S.J. de; Poletiek, M.; Vermaseren, J.A.M. (Nationaal Inst. voor Kernfysica en Hoge-Energiefysica (NIKHEF), Amsterdam (Netherlands). Sectie H). Jan 1988. 9p. NTIS (US Sales Only), PC A02/MF A01. Order Number DE88703938/JAW.

We present cross sections for heavy flavour production through photon gluon fusion in electron proton collisions at HERA energy. The electron photon vertex is taken into account explicitly, and the Q/sup 2/ of the exchanged photon ranges from nearly zero (almost real photon) to the kinematically allowed maximum. In our approach the QCD scale is set by the mass of the produced quarks. Our formalism is also applicable to the production of light quarks as long as the invariant mass of the pair is sufficiently high, so we also give cross sections for uanti u, danti d, and santi s production. 12 refs.; 6 figs.; 3 tabs.

47529 **(SLAC-PUB—4652) Strange quark spectroscopy from the LASS [Large Aperture Superconducting Solenoid] spectrometer.** Aston, D.; Awaji, N.; Bienz, T.; Bird, F.; D'Amore, J.; Dunwoodie, W.; Endorf, R.; Fujii, K.; Hayashii, H.; Iwata, S.; Johnson, W.B.; Kajikawa, R.; Kunz, P.; Leith, D.W.G.S.; Levinson, L.; Matsui, T.; Meadows, B.T.; Miyamoto, A.; Nussbaum, M.; Ozaki, H.; Pak, C.O.; Ratcliff, B.N.; Schultz, D.; Shapiro, S.; Shimomura, T.; Sinervo, P.K.; Sugiyama, A.; Suzuki, S.; Tarnopolsky, G.; Tauchi, T.; Toge, N.; Ukai, K.; Waite, A.; Williams, S. (Stanford Linear Accelerator Center, Menlo Park, CA (USA)). 29 Jun 1988. Contract AC03-76SF00515. 15p. (CONF-8805142—19). NTIS, PC A03/MF A01; 1; GPO Dep. Order Number DE88015336/JAW.

From 3. international conference on the intersections between particle and nuclear physics; Rockport, ME, USA (14 May 1988).

A brief summary is presented of results pertinent to strange quark spectroscopy derived from high statistics data on K/sup {minus}/p interactions obtained with the LASS spectrometer at SLAC.

47530 **(TRI-PP—88-31) The p{bar char}p annihilation in the quark model.** Niskanen, J.A. (TRIUMF, Vancouver, British Columbia (Canada)). May 1988. 5p. (CONF-880331—8). NTIS (US Sales Only), PC A02; 1; GPO Dep. Order Number DE88013284/JAW.

From 3. Lake Louise Winter Institute on quantum chromodynamics: theory and experiment; Lake Louise, Canada (6 Mar 1988).

After a concise review of the N{bar char}N annihilation in the quark rearrangement and $^3P_0$ annihilation models, preliminary results are given for the case with an additional term where a q{bar char}q pair with the gluon quantum number $^3S_1$. 14 refs., 5 figs.

47531 **Precision measurement of R = σ/sub L//σ/sub T/ and F_2 in deep-inelastic electron scattering.** Dasu, S.; de Barbaro, P.; Bodek, A.; Harada, H.; Krasny, M.W.; Lang, K.; Riordan, E.M.; Arnold, R.; Benton, D.; Bosted, P.; and others. (University of Rochester, Rochester, New York 14627). *Physical Review Letters;* **61**: No. 9, 1061-1064(29 Aug 1988).

We report new results on a precision measurement of the ratio R = σ/sub L//σ/sub T/ and the structure function F_2 for deep-inelastic electron-nucleon scattering in the kinematic range $0.2 \leq x \leq 0.5$ and $1 \leq Q^2 \leq 10$ (GeV/c)^2. Our results show, for the first time, a clear falloff of R with increasing Q^2. Our R and F_2 results are in good agreement with QCD predictions only when corrections for target-mass effects are included.

47532 **Experimental mass limit for the fourth-generation sequential lepton from e^+e^- annihilations at √s-bar = 56 GeV.** Kim, G.N.; Kim, E.J.; Son, D.; Bacala, A.; Imlay, R.; Kirk, P.; McNeil, R.R.; Metcalf, W.; Cheng, C.P.; Mao, Z.P.; and others. (Kyungpook National University, Taegu 635). *Physical Review Letters;* **61**: No. 8, 911-914(22 Aug 1988).

A search for pair production for fourth-generation sequential leptons in e^+e^- annihilation at a center-of-mass energy √s = 56 GeV is reported. Event topologies corresponding to the cases where one particle decays leptonically while the other decays hadronically as well as those where both particles decay hadronically were explored. We set a 95%-confidence-level lower limit of 27.6 GeV/c^2 for the mass of a fourth-generation lepton.

47533 **Evidence for iota(1460) production in πp p interactions at 21.4 GeV/c.** Rath, M.G.; Cason, N.M.; Bensinger, J.R.; Bishop, J.M.; Biswas, N.N.; Busenitz, J.K.; Etkin, A.; Foley, K.J.; Fortner, M.R.; Fortney, L.R.; and others. (University of Notre Dame, Notre Dame, Indiana 46556). *Physical Review Letters;* **61**: No. 7, 802-805(15 Aug 1988).

The K/sub S/°K/sub S/°π° system has been studied in the exclusive reaction π^-p→K/sub S/°K/sub S/°π°n at 21.4 GeV/c. Evidence for the production of the f_1(1285) and the eta(1460) is presented. The eta(1460) is produced away from minimum momentum transfer in the presence of nonresonant K/sup */K (S-wave) production and phase-space background. The observed mass, width, and decay properties of the eta(1460) are consistent with those attributed to the iota(1460) observed in radiative J/psi decay.

47534 **Measurement of the nuclear slope parameter of the pp-bar elastic-scattering distribution at $\sqrt{s}$ = 1800 GeV.** Amos, N.A.; Baker, W.F.; Bertani, M.; Block, M.M.; DeSalvo, R.; Dimitroyannis, D.A.; Donati, A.; Eartly, D.P.; Ellsworth, R.W.; Giacomelli, G.; and others. (Universita di Bologna and Istituto Nazionale di Fisica Nucleare, Bologna, Italy). *Physical Review Letters;* **61**: No. 5, 525-528(1 Aug 1988).

We have studied proton-antiproton elastic scattering at $\sqrt{s}$ = 1800 GeV at the Fermilab Collider, in the range 0.02<chemical bondtchemical bond<0.13 (GeV/c)^2. Fitting the distribution by exp(-Bchemical bondtchemical bond), we obtain a value of B of 17.2 +- 1.3 (GeV/c)/sup -2/.

47535 **Measurement of pion-proton bremsstrahlung for pions at 299 MeV.** Meyer, C.A.; Amsler, C.; Bosshard, A.; Crowe, K.M.; Doebeli, M.; Doser, M.; van Elmbt, L.; Haddock, R.P.; Ingram, Q.; Ljungfelt, S.; and others. (Physik-Institut der Universitaet Zuerich, CH-8001 Zuerich, Switzerland University of California, Berkeley). *Physical Review [Section] D: Particles and Fields;* **38**: No. 3, 754-767(1 Aug 1988).

We have measured the fivefold differential cross section $d^5\sigma/d\Omega$/sub $\pi/d\Omega$/sub γ/dE/sub γ/ for the process π^+p→π^+pγ with incident pions of energy 299 MeV. The angular regions for the outgoing pions ($55° \leqq \theta$/sub lab//sup $\pi/\leqq 95°$), and photons (θ/sub lab//sup $\gamma/ = 241° +- 10°$) in coplanar geometry are selected to maximize the sensitivity to the radiation from the magnetic dipole moment of the Δ/sup ++/(1232) resonance. At low photon energies, the data agree with the soft-photon approximation to pion-proton bremsstrahlung. At forward pion angles the data agree with older data and with the latest theoretical calculations for 2.3μ/sub p/$\leqq \mu$/sub $\Delta/\leqq 3.3\mu$/sub p/. However at more backward pion angles where no data existed, the predictions fail.

47536 **Contained neutrino interactions in an underground water detector.** Bionta, R.M.; Blewitt, G.; Bratton, C.B.; Casper, D.; Claus, R.; Cortez, B.; Errede, S.; Foster, G.; Gajewski, W.; Ganezer, K.S.; and others. (University of California, Irvine, California 92717 University of Michigan, Ann Arbor, Michigan 48109 Brookhaven National Laboratory, Upton, New York 11973 California Institute of Technology, Pasadena, California 91125 Cleveland State University, Cleveland, Ohio 44115 University of Hawaii, Honolulu, Hawaii 96822). *Physical Review [Section] D: Particles and Fields;* **38**: No. 3, 768-775(1 Aug 1988).

We study 401 neutrino interactions which have been collected in a massive, well-shielded underground detector. The sample is used to test for neutrino oscillations with a sensitivity in $\Delta m^2 \geqq 4.2$ x 10/sup -5/ eV^2 at maximum mixing (90% confidence level). A search is made for terrestrial and extraterrestrial point sources of neutrinos. A limit on point sources in the energy range 500—2000 MeV is given. A search is made for possible evidence for geomagnetic effects on the data. Most of the neutrinos are likely of atmospheric origin.

47537 **Spin-parameter measurements in Λ and K/sub S/ production.** Bonner, B.E.; Buchanan, J.A.; Clement, J.M.; Corcoran, M.D.; Kruk, J.W.; Miettinen, H.E.; Moss, R.M.; Mutchler, G.S.; Nessi-Tedaldi, F.; Nessi, M.; and others. (T. W. Bonner Laboratories, Physics Department, Rice University, Houston, Texas 77251). *Physical Review [Section] D: Particles and Fields;* **38**: No. 3, 729-741(1 Aug 1988).

The Brookhaven Alternating Gradient Synchrotron polarized proton beam incident on a beryllium target was used for inclusive Λ production at beam momenta of 13.3 and 18.5 GeV/c. The beam polarization was transverse to the beam direction with magnitude 0.63 at 13.3 GeV/c and 0.40 at 18.5 GeV/c. The Λ polarization was measured and found to be in agreement with results from earlier experiments which used unpolarized proton beams. Analyzing power A/sub N/ and spin transfer D/sub N//sub N/ of the Λ's were both measured and compared with a hyperon-polarization model in which the polarization arises from a Thomas-precession effect. There is good agreement with its predictions: A/sub N/ = 0 and D/sub N//sub N/ = 0. In particular, our measurement of <D/sub N//sub N/> = -0.009 +- 0.015 supports the idea that the valence quarks carry all of the hadron spin, since this assumption is implicit in the model's use of SU(6) wave functions to form final-state hadrons from beam fragments and sea quarks. The presence of substantial K/sub S/ samples at both beam momenta and Lambda-bar's at 18.5 GeV/c prompted a measurement of their analyzing powers, which yielded A/sub N/(K/sub S/) = -0.094 +- 0.012 at 13.3 GeV/c beam momentum and -0.076 +- 0.015 at 18.5 GeV/c, and A/sub N/(Lambda-bar) = 0.03 +- 0.10.

47538 **Monte Carlo particle transport on parallel processors.** Martin, W.R. (Univ. of Michigan, Ann Arbor (USA)). *Transactions of the American Nuclear Society;* **55**: 324-325(1987). (CONF-8711195—).

From American Nuclear Society winter meeting; Los Angeles, CA, USA (15 Nov 1987).

Recent increases in computer performance have been due to innovations in computer architecture as well as improvements in hardware speed. In particular, several vendors are now offering parallel processors, including multiple vector processors as well as multiple scalar processors. Recent progress has been made in developing parallel algorithms for particle transport Monte Carlo code for both shared memory and distributed memory parallel processors, with measured timing results for a photon transport application on two different parallel processors.

6452 Particle Interactions And Properties - Theoretical

REFER ALSO TO CITATION(S) 47440, 47445, 47446, 47576, 47589, 47594, 47596, 47597, 47993

47539 **(BARI-TH—88-19) Transverse polarization in inclusive hyperon production.** Nardulli, G. (Bari Univ. (Italy). Dipt. di Fisica). Feb 1988. 4p. (CONF-880189—2). NTIS (US Sales Only), PC A02; 1; GPO Dep. Order Number DE88012570/JAW.

From Adratico research conference on spin and polarization dynamics in nuclear and particle physics; Trieste, Italy (1 Jan 1988).

We review different theoretical attempts to explain the large transverse hyperon polarization observed in high energy inclusive hadron reactions. In particular we stress the role of final state effects (resonance interference) in the {LAMBDA} polarization at small p/sub T/ and large x/sub F/. 15 refs.

47540 **(BNL—41442) Neutrino masses, mixing, moments, and matter.** Marciano, W.J. (Brookhaven National Lab., Upton, NY (USA)). 1988. Contract AC02-76CH00016. 16p. (CONF-8805142—15). NTIS, PC A03/MF A01; GPO Dep. Order Number DE88014289/JAW.

From 3. international conference on the intersections between particle and nuclear physics; Rockport, ME, USA (14 May 1988).

The present status of neutrino masses, mixing, and electromagnetic moments is surveyed. Potential enhancements of neutrino oscillations, decay, and spin-flavor precession due to their interactions with matter are described.

47541 **(BNL—41503) Nucleon-antinucleon annihilation dynamics.** Dover, C.B. (Brookhaven National Lab., Upton, NY (USA)). 1988. Contract AC02-76CH00016. 9p. (CONF-8805142—14). NTIS, PC A02/MF A01; 1; GPO Dep. Order Number DE88014290/JAW.

From 3. international conference on the intersections between particle and nuclear physics; Rockport, ME, USA (14 May 1988).

Recent progress towards a microscopic understanding of nucleon- antinucleon N{ovr N} annihilation is reviewed. We consider

statistical models, the constraints imposed by SU(2) or SU(3) flavor symmetry and the spin-flavor-color dependence of effective operators for the creation/destruction of quark-antiquark (Q{ovr Q}) pairs in N{ovr N} annihilation processes. The importance of dynamical selection rules is emphasized as a means of revealing the underlying reaction mechanism. 15 refs., 1 fig.

47542 (CERN-EP—87-232) B-physics with pp colliders. Fridman, A. (European Organization for Nuclear Research, Geneva (Switzerland)). 23 Dec 1987. 22p. (CONF-8709224—4). NTIS (US Sales Only), PC A03; 1; GPO Dep. Order Number DE88012607/JAW.

From B-meson factory workshop; Stanford, CA, USA (8 Sep 1987).

As the construction of pp colliders in the multi-TeV region (LHC, SSC, or ELOISATRON) is under discussion, we briefly examine the possibility of investigating B physics in pp collisions. The rates and general features of B{bar B} production are discussed and the potentialities for tagging B's in very large multiplicity events are envisaged. Some physics points requiring large B{bar B} data samples (CP violation in the B system and rare B decays) as could be obtained with pp colliders are also presented. In the context of measuring CP violation effects the implications of unequal B and {bar B} production in pp collisions are addressed. 23 refs., 6 figs., 7 tabs.

47543 (CERN-EP—88-59) QCD test at e{sup +}e{sup minus} and pp colliders. Maettig, P. (European Organization for Nuclear Research, Geneva (Switzerland)). 25 May 1988. 52p. (CONF-880331—7). NTIS (US Sales Only), PC A04; 1; GPO Dep. Order Number DE88013865/JAW.

From 3. Lake Louise Winter Institute on quantum chromodynamics: theory and experiment; Lake Louise, Canada (6 Mar 1988).

Measurements on the dynamics of strong interactions as well as of their fundamental parameters are reviewed. Data from pp--collisions and from e{sup +}e{sup minus}--annihilations exhibit the features characteristic for QCD such as the Q{sup 2} dependence of the jet-jet cross section, the existence of gluon bremsstrahlung and the properties of gluons. QCD provides a consistent framework to describe all hadronic data. However, due to experimental and theoretical uncertainties QCD tests are not very precise. The most reliable determination of the strong coupling constant {alpha}{sub s} is reached by combining all existing measurements of the hadronic cross section in e{sup +}e{sup minus}--annihilation yielding {alpha}{sub s}(1156GeV{sup 2})=0.145{plus-minus}0.019. The higher Q{sup 2} and larger statistics available at the future colliders will allow for qualitative tests of many important elements of QCD, however, progress in precision tests will be slow. Still, in view of its overall agreement with the data QCD is to be considered the theory of strong interactions. 185 refs., 28 figs., 5 tabs.

47544 (DOE/ER/40226—T1) Theoretical investigations in elementary particle physics: Progress report, June 1987{endash}May 31, 1988. Weiler, T.J.; Kephart, T.W. (Vanderbilt Univ., Nashville, TN (USA). Dept. of Physics and Astronomy). Jan 1988. Contract FG05-85ER40226. 10p. NTIS, PC A02/MF A01; GPO Dep. Order Number DE88008645/JAW.

Progress is reported in the area of two-loop anomalies in open superstrings and modular invariance in lower dimensional superstring theories. Also discussed is neutrino emission from SN1987A. (LEW)

47545 (IC—88/60) O(5)xU(1) electro weak gauge theory and the triggering of the Cabbibo-rotation by 't Hooft-Polyakov monopole. Samiullah, M. (International Centre for Theoretical Physics, Trieste (Italy)). Mar 1988. 23p. NTIS (US Sales Only), PC A03/MF A01. Order Number DE88703843/JAW.

The present study is based on the O(5)xU(1) ElectroWeak gauge theory with the two particle generations of quarks. With the spontaneously symmetry breaking down to the O(3) level the 't Hooft-Polyakov SO(3) monopole theory along with its triplet of scalar fields is reproduced and developed to the extent necessary to establish our results. It is shown that the existence of the monopole triggers the Cabibbo rotation of d and s flavours. It is exactly the Cabibbo angle in which the isovector phi-bar has to be rotated so as to spontaneously break the symmetry down to the O(3) level, together with, on the SO(3) sector to the U(1) level. As a byproduct it turns out that the Weinberg angle is twice the Cabbibo angle, a result already noted by the author elsewhere. (author). 17 refs.

47546 (IC—88/65) Leptons as systems of Dirac particles. Borstnik, N.M.; Kaluza, M. (International Centre for Theoretical Physics, Trieste (Italy); Institut Jozef Stefan, Ljubljana (Yugoslavia)). (International Centre for Theoretical Physics, Trieste (Italy)). Mar 1988. 18p. NTIS (US Sales Only), PC A03/MF A01. Order Number DE88703847/JAW.

Charged leptons are treated as systems of three equal independent Dirac particles in an external static effective potential which has a vector and a scalar term. The potential is constructed to reproduce the experimental mass spectrum of the charged leptons. The Dirac covariant equation for three interacting particles is discussed in order to comment on the magnetic moment of leptons. (author). 9 refs, 2 figs, 4 tabs.

47547 (ITEF—173(1987)) Calculation of production cross sections of possible S/sub E/ exotic state also as Σ/sup *-/ (1385),Σ/sup -/ and Λ/sup 0/ in Σ/sup -/p interaction at p=30 and 50 GeV/c. Nilov, A.F. (Gosudarstvennyj Komitet po Ispol'zovaniyu Atomnoj Ehnergii SSSR, Moscow. Inst. Teoreticheskoj i Ehksperimental'noj Fiziki). 1987. 20p. (In Russian). NTIS (US Sales Only), PC A03/MF A01. Order Number DE88703606/JAW.

With a purpose to verify the Regge one-pion exchange model, the cross section of inclusive production of γ/sup 0/ (1530) resonance in the γ/sup -/p interaction with incident momentum 135 GeV/c was calculated. Within the framework of this model the cross section of exclusive and inclusive production of exotic baryons S/sub E/ -> Σ/sup -/PI/sup -/, S/sub E/' -> Σ/sup *-/ (1385)PI/sup -/ and production cross section of Σ/sup */ (1385), Σ/sup -/, Λ/sup 0/ hyperons in Σ/sup -/p interaction at momenta of 30 and 50 GeV/c were calculated. Different properties of the produced hyperon systems are examined. 4 refs.; 8 figs.

47548 (ITEP—58(1987)) Effects of multiquark bags in the quark potential model. Applications to nucleon-nucleon scattering. Kalashnikova, Yu.S.; Narodetskij, I.M. (Gosudarstvennyj Komitet po Ispol'zovaniyu Atomnoj Ehnergii SSSR, Moscow. Inst. Teoreticheskoj i Ehksperimental'noj Fiziki). 1987. 33p. NTIS (US Sales Only), PC A03/MF A01. Order Number DE88703926/JAW.

The effects of the explicit treatment of multiquark confined states in the quark potential model are studied for the two-nucleon system. The confined six-quark component in the nucleon-nucleon wave function is shown to generate a new mechanism for the short-range nucleon-nucleon interaction which qualitatively reproduces both the repulsion and medium-range attraction properties of the nuclear force. It is found that for an appropriate choice of parameters the NN forces generated by an admixture of multiquark confined states can bind the six-quark system in the deuteron-like bound state and qualitatively reproduces the low-energy phase-shift behaviour. Obtained results may be also considered as the first example of dynamical calculations of nucleon-nucleon scattering in the quark compound bag method using the explicit form of the six quark Hamiltonian. 26 refs.; 4 figs.

47549 (ITEP—168(1987)) Hyperon-nucleon interaction and the 2.13 GeV strange dibaryonic system in the P-matrix approach. Bakker, B.L.G.; Daling, R.; Kerbikov, B.O. (Gosudarstvennyj Komitet po Ispol'zovaniyu Atomnoj Ehnergii SSSR, Moscow. Inst. Teoreticheskoj i Ehksperimental'noj Fiziki). 1987. 25p. NTIS (US Sales Only), PC A03/MF A01. Order Number DE88703619/JAW.

A description is presented of the low-energy YN (Y=Λ,Σ) interactions within the Jaffe-Low P-matrix formalism. Enchancement of the Λ/sub p/ invariant mass near the Σ/sup +/n threshold may be identified as an F-matrix partner of the deuteron and not as a six-quark dibaryon resonance. 29 refs.; 8 figs.

47550 **(JINR—D-6-87-403) Investigation of antineutrino mass estimate properties in idealized tritium experiment.** Pokrovskij, V.N.; Vylov, Ts.; Prostakov, I.A.; Chistyakov, V.P.; Briancon, C. (Joint Inst. for Nuclear Research, Dubna (USSR). Lab. of Nuclear Problems). 1987. 12p. NTIS (US Sales Only), PC A03/MF A01. Order Number DE88703673/JAW.

The paper deals with the influence of errors in assignment of a priori parameters of the tritium experiment idealized model upon the bias of the estimate vector of searched for parameters (antineutrino mass, spectrum end-point energy, effect-to-background ratio). Results of numerical simulation and consideration of the total covariance matrix indicate at strong correlation of estimates and at possible generation of the antineutrino mass, e.g. owing to overestimation of the response function width or its asymmetry degree as well as at underestimation of the probability of the decay into the ground state. Attention is paid to advantages of the method based on consideration of the covariance matrix. 9 refs.; 4 figs.; 1 tab.

47551 **(JINR—R-1-87-552) Clusterization in four-dimensional relative velocity space and invariant distributions of hadron jets.** Baldin, A.M.; Grishin, V.G.; Didenko, L.A.; Kuznetsov, A.A.; Metreveli, Z.V. (Joint Inst. for Nuclear Research, Dubna (USSR). Lab. of High Energy; Tbilisskij Gosudarstvennyj Univ. (USSR)). (Joint Inst. for Nuclear Research, Dubna (USSR). Lab. of High Energy). 1987. 19p. (In Russian). NTIS (US Sales Only), PC A03/MF A01. Order Number DE88703716/JAW.

Submitted to the journal Sov. J. Nucl. Phys. .

The new relativistic invariant method for separation of hadron jets is considered. It is based on minimization of the sum of squared relativistic four-dimensional velocities and is used for analysing jet properties in π/sup -/p- andπ/sup -/C-interactions at 40 GeV/c and pp-interactions at P=205 GeV/c. It has been observed that two hadron jets are formed mainly in these types of interactions: one of them in the beam particle fragmentation region and the second-in the target particle fragmentation region. The automodel properties of invariant function W(b/sub αk/, b/sub βk/, b/sub $\alpha\beta$/, ...), where α and β are the jets, producted in the regions of target and beam fragmentation in different type collisions, is investigated experimentally in the space of four-dimensional velocities. It is shown that the distributions of pions in jets over x/sub k/=b/sub αk//bα/sub β/, b/sub βk//b/sub $\alpha\beta$/ variable have universal character for various types of interactions in the P/sub lab/=40-205 GeV/c region. The dependence of invariant function E/sub s/d/sup 3/σ/dp-vector/sub s//sup 3/ for jets on their four-velocities with respect to primary interaction particles b/sub s2/ and b/sub s1/ is studied. It is shown that the fragmenting quark objects in pions, nucleons and multiquark configurations of carbon nucleus which are a source of pion jets have the identical effective mass mainly. The invariant distributions for pion jets are analysed. It has been observed that the distributions of fragmenting quark object in pion nucleon and multiquark configurations of carbon nucleus have different character. 8 refs.; 13 figs.; 3 tabs.

47552 **(LA-UR—88-1857) Exotic decays of light mesons.** Herczeg, P. (Los Alamos National Lab., NM (USA)). 1988. Contract W-7405-ENG-36. 32p. (CONF-8803108—3). NTIS, PC A03/MF A01; 1; GPO Dep. Order Number DE88014454/JAW.

From Workshop on production and decay of light mesons; Paris, France (3 Mar 1988).

We discuss the information one could obtain on physics beyond the minimal standard model from studies of the rare and forbidden decays of {pi}{sup 0}, {eta} and {eta}{prime}. 82 refs.

47553 **(LA-UR—88-1940) Multiquark interactions.** Goldman, T.; Maltman, K.R.; Schmidt, K.E.; Stephenson, G.J. Jr. (Los Alamos National Lab., NM (USA)). 1988. Contract W-7405-ENG-36. 16p. (CONF-880560—4). NTIS, PC A03/MF A01; 1; GPO Dep. Order Number DE88014443/JAW.

From Topical conference on nuclear quantum chromodynamics; Argonne, IL, USA (19 May 1988).

The conflict between the description of a field theory by its asymptotic states and the confinement of quarks in QCD is discussed. It is argued that a correct hadronic description of QCD (in terms of color singlets) may require very unusual vertex functions, despite the overlap of parts of the path integral with natural hadronic degrees-of-freedom. A formalism, which incorporates many of the advantages of an hadronic description into a quark picture, is described. Dibaryons are presented which show how well this approach illuminates the physics relevant to the multiquark problem. 14 refs., 1 fig., 5 tabs.

47554 **(NIKHEF-H—87-16) Spinning superparticle.** Kowalski-Glikman, J.; Holten, J.W. van; Aoyama, S.; Lukierski, J. (Nationaal Inst. voor Kernfysica en Hoge-Energiefysica (NIKHEF), Amsterdam (Netherlands). Sectie H; Karlsruhe Univ. (Germany, F.R.). Inst. for Theoretical Physics; Wroclaw Univ. (Poland). Inst. Fizyki Teoretycznej). (Nationaal Inst. voor Kernfysica en Hoge-Energiefysica (NIKHEF), Amsterdam (Netherlands). Sectie H). Sep 1987. 6p. NTIS (US Sales Only), PC A02/MF A01. Order Number DE88703932/JAW.

Doubly graded massless supersymmetric particle models with both world-line local and space-time global supersymmetry are considered. The first quantization of the model with four-dimensional space-time and N=1 world-line SUSY is described. Using the Gupta-Bleuler method a pair of D=4 chiral spinor superfields as the super wave-function is obtained with the on-shell spectrum containing scalar and vector multiplets. 18 refs.

47555 **(NIKHEF-H—87-19) Spinning superparticle II: a spectrum in ten dimensions.** Kowalski-Glikman, J. (Nationaal Inst. voor Kernfysica en Hoge-Energiefysica (NIKHEF), Amsterdam (Netherlands). Sectie H). 16 Nov 1987. 9p. NTIS (US Sales Only), PC A02/MF A01. Order Number DE88703934/JAW.

The quantization is presented of the spinning superparticle model in ten space-time dimensions. The resulting wave function represents two spin 3/2 multiplets for type I and spin 5/2 multiplets for type II theories. 8 refs.

47556 **Like-charged gauge-boson pairs as a probe of electroweak symmetry breaking.** Chanowitz, M.S.; Golden, M. (Lawrence Berkeley Laboratory, University of California, Berkeley, California 94720). *Physical Review Letters;* 61: No. 9, 1053-1056(29 Aug 1988).

Pairs of like-charged W bosons, W^+W^+ and W^-W^-, are a unique probe of the electroweak-symmetry-breaking sector since they have no background from qq-bar annihilation. We compute the observable signal in several models and the irreducible QCD background. We find that the signal will be observable at the Superconducting Super Collider (SSC) if and only if the symmetry-breaking sector is strongly interacting, provided that the SSC operates at full energy and luminosity.

47557 **Global Monte Carlo algorithms for many-fermion systems.** Creutz, M. (Physics Department, Brookhaven National Laboratory, Upton, New York 11973). *Physical Review [Section] D: Particles and Fields;* 38: No. 4, 1228-1238(15 Aug 1988).

I discuss algorithms for simulating many-fermion systems via global updatings of auxiliary fields followed by an accept-reject stage which eliminates finite-step-size errors. When the system size is larger than the correlation length, these procedures should require computer time growing only slightly faster than linearly with the system volume V. A corrected Langevin scheme should asymptotically display a V/sup 4/3/ behavior, while the hybrid Monte Carlo scheme can behave as V/sup 5/4/. I present some tests of the latter algorithm on a simple model of interacting electrons on a two-dimensional lattice.

47558 **Natural hierarchy of radiatively induced Majorana neutrino masses.** Babu, K.S.; Ma, E. (Department of Physics & Astronomy, University of Rochester, Rochester, New York 14627). *Physical Review Letters;* 61: No. 6, 674-677(8 Aug 1988).

Radiative Majorana masses for the three known neutrinos can be generated via the exchange of two W bosons if there is a fourth neutrino with both Dirac and Majorana masses. Typical

masses of the order 10/sup -8/, 10/sup -3/, and 10^3 eV are obtained.

47559 **Upper bound on the Higgs-boson mass in the standard model.** Kuti, J.; Lin, L.; Shen, Y. (Department of Physics, University of California at San Diego, La Jolla, California 92093). *Physical Review Letters;* **61**: No. 6, 678-681(8 Aug 1988).

The electroweak model with one Higgs doublet is investigated when the mass of the Higgs particle is larger than the weak-interaction scale. It is shown that the SU(2) Higgs sector with spontaneously broken O(4) symmetry and perturbative gauge coupling becomes a trivial field theory at infinite cutoff. Around the trivial Gaussian fixed point, for finite cutoff, a low-energy effective theory is found with nontrivial couplings and mass generation from spontaneous symmetry breaking. We find an upper bound of M/sub H/≤640 GeV on the mass of the Higgs particle with a lattice momentum cutoff 2π times larger than the Higgs-boson mass.

47560 **Effects of the hadronic structure of the photon at the DESY ep collider HERA.** Drees, M.; Godbole, R.M. (Physics Department, University of Wisconsin, Madison, Wisconsin 53706). *Physical Review Letters;* **61**: No. 6, 682-685(8 Aug 1988).

We investigate the production of hadronic jets with high transverse momenta p/sub T/ at the forthcoming DESY ep collider HERA. We find that events where the exchanged quasireal photon is resolved into quarks and gluons dominate the two-jet cross section for p/sub T/approx. <40 GeV. We also find that this class of events contributes about 20% to the total bb-bar and cc-bar production. The possibility to use these processes to measure the gluon content of the photon is discussed.

47561 **B → sγ in the two-Higgs-doublet model.** Rizzo, T.G. (Ames Laboratory and Department of Physics, Iowa State University, Ames, Iowa 50011). *Physical Review* [*Section*] *D: Particles and Fields;* **38**: No. 3, 820-823(1 Aug 1988).

The processes b→sγ and b→sg are examined within the context of the two-Higgs-doublet extension of the standard model. The usual W^- loop diagrams responsible for these decays are now supplemented by loops involving charged Higgs bosons (H^-). We find that the total amplitudes for both processes are substantially enhanced in this model for a wide range of top-quark and charged-Higgs-boson masses. For a reasonable range of the ratio of the vacuum expectation values of the two Higgs doublets, these decays can provide important tests of such models.

47562 **On estimating mean lifetimes in the presence of background.** Prosper, H.B. (Fermi National Accelerator Laboratory, P.O. Box 500, Batavia, Illinois 60510). *Physical Review* [*Section*] *D: Particles and Fields;* **38**: No. 3, 854-859(1 Aug 1988).

The exact sampling theory pertaining to the problem of estimating the mean lifetime of a particle, when the data sample contains contributions from several background sources and when the detection efficiency is uniform over the sample space, is developed in detail. Measurement errors are taken into account, on an event-by-event basis, by assuming the experimental resolution function to be a Gaussian distribution of known variance and zero mean. This model is widely used to analyze lifetime data from collider experiments. While the results presented are valid for samples of any size they are more suited to the analysis of data samples containing few events. In this sense they offer a method of analysis which is complementary to the method of maximum likelihood.

47563 **Mixing between ordinary and exotic fermions.** Langacker, P.; London, D. (Deutsches Elektronen Synchrotron—DESY, Hamburg, Federal Republic of Germany). *Physical Review* [*Section*] *D: Particles and Fields;* **38**: No. 3, 886-906(1 Aug 1988).

The results of a comprehensive analysis of the limits on mixings between ordinary fermions and possible heavy fermions with exotic SU(2) x U(1) assignments (e.g., left-handed singlets and/or right-handed doublets) are presented. A general formalism for describing such mixings is given. It is shown that a variety of constraints, including the relation between the W and Z masses and the Fermi constant, charged-current universality, limits on induced right-handed charged currents, and flavor-diagonal neutral currents suffice to limit all directions in parameter space that are not excluded by the absence of flavor-changing neutral currents. Limits on s^2, the square of the mixing between ordinary and exotic fermions, are quite stringent for the ν/sub μ//sub L/, μ/sub L/⁻, u/sub L/, and d/sub L/ ($s^2 \leq 0.002$—0.005) if only one particle is allowed to mix at a time, but are weaker by an order of magnitude if fine-tuned cancellations between different mixings are allowed. Similar statements apply to quark mixings with heavy sequential doublets. Limits on s^2 for the other light fermions (ν/sub e//sub L/, e/sub L/⁻,e/sub R/⁻,μ/sub R/⁻, u/sub R/,d/sub R/) are in the range 0.02—0.06, while those for the s, c, b, ν/sub tau/, and tau⁻ are considerably weaker. Slightly stronger limits are found in specific models (e.g., E_6). Implications for the masses of the heavy exotic fermions are discussed.

47564 **Exclusive production of heavy mesons in e^+e^- annihilation.** Amiri, F.; Ji, C. (Stanford Linear Accelerator Center, Stanford University, Stanford, California 94305). *Physical Review* [*Section*] *D: Particles and Fields;* **38**: No. 3, 776-781(1 Aug 1988).

Within the framework of a particular model for meson production, we have performed a perturbative QCD analysis for exclusive pair production of heavy mesons. Analytic calculations of angular distributions for pseudoscalar-pseudoscalar, vector-pseudoscalar, and vector-vector mesons are presented. Numerical estimates of the cross section, angular distributions, and forward-backward asymmetry for various B, B/sup */, T, and T/sup */ mesons are given at an energy range of 20—100 GeV. The forward-backward asymmetry from weak-electromagnetic interference is found to be large at the energy (around 50 GeV) of the KEK collider TRISTAN.

47565 **Tau missing-decay-mode problem and limits on a second tau neutrino.** Perl, M.L. (Stanford Linear Accelerator Center, Stanford University, Stanford, California 94305). *Physical Review* [*Section*] *D: Particles and Fields;* **38**: No. 3, 845-849(1 Aug 1988).

This paper quantitatively considers the hypothesis that the tau missing-mode problem might be explained by the existence of a second and massive tau neutrino, with mass less than the tau mass. I find that the tau missing-mode problem cannot be explained when the hypothesis is formulated according to conventional weak-interaction concepts.

47566 **Disruption effects from the interaction of round e^+e^- beams.** Chen, P.; Yokoya, K. (Stanford Linear Accelerator Center, Stanford University, Stanford, California 94305). *Physical Review* [*Section*] *D: Particles and Fields;* **38**: No. 3, 987-1000(1 Aug 1988).

We report on our recent simulation results on the disruption effects during the interaction of round e^+e^- beams in linear colliders. It is found that in addition to the well-known disruption parameter D, the disruption effects also depend on another parameter Aequivalentσ/sub z//β/sup */, where σ/sub z/ is the bunch length and β/sup */ the β function at the interaction point. It turns out that while the luminosity enhancement factor H/sub D/ is insensitive to A only in the small-D (Dapprox. <1) regime, the disruption-angle enhancement factor H/sub θ/ behaves oppositely. Specifically, we found that for large D, H/sub θ/ is suppressed as $1/\sqrt{D}$, and H/sub D/ increases monotonically without saturation. Moreover, for fixed D, H/sub D/ varies as a function of ln(1/A). Computer analysis further suggests that in the large-D and small-A regime a confinement mechanism is developed near the beginning of the collision: particles once pinched tend to be trapped in a much smaller radius throughout the process. A theoretical model is provided to qualitatively explain the above findings.

47567 Measurement of the imaginary part of the I = 1 N-barN S-wave scattering length. Mutchler, G.S.; Clement, J.; Kruk, J.; Moss, R.; Hungerford, E.; Kishimoto, T.; Mayes, B.; Pinsky, L.; Tang, L.; Xue, Y.; and others. (T. W. Bonner Nuclear Laboratories, Physics Department, Rice University , Houston, Texas 77251-1892). *Physical Review [Section] D: Particles and Fields;* **38**: No. 3, 742-753(1 Aug 1988).

The survival time spectrum of slow antineutrons produced in a liquid-hydrogen target has been measured. From these data the imaginary part of the I = 1 spin-averaged S-wave antineutron proton scattering length has been deduced to be $Im a_1 = -0.83 +- 0.07$ fm. The result lies within the range of values calculated from current potential models. In addition, by combining a_1 with the antiproton-proton scattering length deduced from antiprotonic atoms, the imaginary part of the I = 0 spin-averaged N-barN scattering length was calculated to be $Im a_0 = -1.07 +- 0.16$ fm.

47568 Vector- and tensor-meson production and the Pomeron-f identity hypothesis. Jones, S.T. (Department of Physics and Astronomy, The University of Alabama, Tuscaloosa, Alabama 35487). *Physical Review [Section] D: Particles and Fields;* **38**: No. 3, 782-787(1 Aug 1988).

Within the context of a model introduced some time ago, the differential and total production cross sections for vector and tensor mesons are shown to be compatible with the hypothesis that the Pomeron and f are a single Regge trajectory. The model incorporates both cylinder and flavoring renormalizations of the Pomeron-f trajectory. The processes K/sup +- /p→K/sup */(892)/sup +- /p, K/sup +- /p →K_A/sup */(1430)/sup +- /p, and π/sup +- /p→A_3(1320)/sup +- /p are analyzed in some detail.

47569 Dependence in nuclear Drell-Yan processes including QCD corrections. Hwang, W.P.; Kisslinger, L.S. (Department of Physics, National Taiwan University, Taipei, Taiwan 10764, Republic of China). *Physical Review [Section] D: Particles and Fields;* **38**: No. 3, 788-797(1 Aug 1988).

In treating leading-order QCD corrections to deep-inelastic scattering and the Drell-Yan process, one assumes that collinear singularities arising from the massless nature of the non-Abelian gauge theory be absorbed into parton distributions through redefinition. It has also been suggested that terms which are not perfectly finite near q/sub perpendicular/ = 0 be suitably exponentiated in the impact-parameter space in order to yield proper predictions on q/sub perpendicular/-dependent effects. These steps may lead to negative partial Drell-Yan cross sections for certain QCD diagrams of order α/sub s/. We modify the formalism developed by Altarelli et al. to ensure that all partial cross sections are non-negative. We use the revised formalism to make predictions on A-dependent effects in the nuclear Drell-Yan process. Our numerical results indicate strongly the potential usefulness of measuring lepton pair production cross sections in a region with a large M/sub μ//sub <+/μ/sup =/ and a large q/sub perpendicular/ so that perturbative QCD theory is expected to play a critical role.

47570 Anomaly-induced amplitudes of new gauge bosons. Chang, D.; Keung, W.; Lee, S. (Physics Department, Northwestern University, Evanston, Illinois 60201). *Physical Review [Section] D: Particles and Fields;* **38**: No. 3, 850-853(1 Aug 1988).

The amplitudes Z'→Zγ and Z'→ZZ in models with an additional U'(1) gauge group beyond the standard SU(2) x U(1) electroweak theory are induced via fermion loops of ordinary states u, d, e, ν, etc., and heavy exotic states which will not cancel among themselves though the anomaly condition is satisfied. An E_6 model is used as an example for the illustration. The new heavy neutral gauge boson Z' could decay into Zγ and ZZ with branching ratios $\Gamma(Z'\to Z\gamma)/\Gamma(Z'\to e^+e^-) \sim 10/$sup -6/ and $\Gamma(Z'\to ZZ)/\Gamma(Z'\to e^+e^-) \sim 10^{-6}$.

47571 Lattice pseudoscalar-meson wave-function properties. DeGrand, T.A.; Loft, R.D. (Physics Department, University of Colorado, Boulder, Colorado 80309). *Physical Review [Section] D: Particles and Fields;* **38**: No. 3, 954-961(1 Aug 1988).

Using lattice gauge theory in the quenched approximation we calculate the decay constants and second moments of wave functions of pseudoscalar mesons containing nonstrange, strange, and charmed quarks. We find f/sub D/ = 134(23) MeV and f/sub D//sub >//sub s/ = 157(11) MeV. We use the methodology of two recent computations of the second moment of the pion wave function, and find that a nonperturbative treatment of operator mixing gives results consistent with calculations using sum rules.

47572 Higgs-boson—Z^0 production from gluon fusion. Dicus, D.A.; Kao, C. (Center for Particle Theory, The University of Texas at Austin, Austin, Texas 78712). *Physical Review [Section] D: Particles and Fields;* **38**: No. 3, 1008-1011(1 Aug 1988).

The contribution to pp→ZH+X from gluon fusion (gg→ZH) is calculated by using three generations and four generations of quarks including both the triangle and box diagrams.

47573 Rephase invariance of KM matrices and CP violation. Dunietz, I. (Enrico Fermi Institute and Department of Physics, University of Chicago, Chicago, Illinois 60637). *Annals of Physics (New York);* **184**: No. 2, 350-415(Jun 1988).

Conventional parametrizations of Kobayashi—Maskawa (KM) matrices ascribe phases to specific matrix elements. Those phases are unphysical, because they change under phase rotations of quark fields. In contrast, rephase-invariant quantities do not change under those rotations. We present three main topics: (a) a rephasing-invariant parametrization of KM matrices, (b) a rephasing-invariant treatment of CP violation in the neutral B (beauty flavored) and K mesons, (c) possible tests of CP and CPT invariance in experiments on vector resonances Y(4S) and phi. copyright 1988 Academic Press, Inc.

6453 Particle Invariance Principles And Symmetries

REFER ALSO TO CITATION(S) 47447, 47559, 47573, 47578, 47582, 47586, 47592, 47595, 47596, 47599, 47600, 47645

47574 (EFI—971(21)-87) 1/N expansion in two-dimensional supersymmetric O(N)xO(K) invariant O(N)/O(N-K) model and dynamic production of massive vector particles. Bratchikov, A.V.; Grigoryan, R.P.; Deriglazov, A.A. (RITTs SO AN SSSR, Tomsk; Erevanskij Fizicheskij Inst. (USSR); Tomskij Gosudarstvennyj Univ. (USSR)). (Erevanskij Fizicheskij Inst. (USSR)). 1987. 14p. NTIS (US Sales Only), PC A03/MF A01. Order Number DE88703817/JAW.

The supersymmetric O(N)xO(K)-invariant O(N)/O(N-K) model is investigated in the framework of 1/N-expansion. It is shown that the massive supermultiplets of fields (vector fields among them) are dynamically produced in the leading over 1/N order. 6 refs.

47575 (LA-UR—88-2062) Tests of time reversal in neutron-nucleus scattering. Bowman, J.D. (Los Alamos National Lab., NM (USA)). 1988. Contract W-7405-ENG-36. 8p. (CONF-8805142—8). NTIS, PC A02/MF A01; 1; GPO Dep. Order Number DE88014421/JAW.

From 3. international conference on the intersections between particle and nuclear physics; Rockport, ME, USA (14 May 1988).

Experiments to test time-reversal invariance are discussed. The experiments are based on observables constructed from the momentum and spin vectors of epithermal neutrons and from the spin of an aligned or polarized target. It is shown that the proposed tests are detailed balance tests of time-reversal invariance. The status of the experiments is briefly reviewed. 14 refs., 5 figs.

47576 Evidence for a Nambu-Goldstone boson. Sikivie, P. (Physics Department, University of Florida, Gainesville, Florida, 32611). *Physical Review Letters;* **61**: No. 7, 783-786(15 Aug 1988).

Cosmic global strings dissipate their energy into Nambu-Goldstone bosons with a 1/k energy spectrum. These Nambu-Gold-

stone bosons can convert to photons in the magnetic fields of various astrophysical objects, in particular galactic halos, clusters of galaxies, and extended radio sources. Evidence that this does in fact occur is found in cosmic-ray and radio astronomy data.

47577 **Quark and lepton masses in superstring-type models with mirror families.** Kagan, A.L.; Albright, C.H. (Enrico Fermi Institute, University of Chicago, Chicago, Illinois 60637). *Physical Review [Section] D: Particles and Fields;* 38: No. 3, 917-934(1 Aug 1988).

We investigate ordinary-mirror fermion mass splitting, quark isospin breaking, and both Majorana and Dirac neutrino mass seesaw mechanisms in the framework of E_8-based superstring-type models with mirror families. Our results suggest that actual realizations containing vectorlike generations should not be overlooked in the search for a realistic low-energy phenomenology.

6454 Field Theory

REFER ALSO TO CITATION(S) 47447, 47448, 47544, 47553, 47557, 47561, 47569, 47570, 47896

47578 **(EFI—963(13)-87) Lagrangian of six-dimensional chiral anomalous supergravities.** Kavalov, A.R.; Mkrtchyan, R.L. (Erevanskij Fizicheskij Inst. (USSR)). 1987. 13p. (In Russian). NTIS (US Sales Only), PC A03/MF A01. Order Number DE88703816/JAW.

The Lagrangian of the minimal six-dimensional anomalous N=2 and N=4b supergravities are constructed which have all symmetries of these theories, in particular, explicit Lorentz-invariance and supersymmetry. They also have an additional local α-symmetry acting nontrivially only off the mass shell. Owing to this symmetry, the commutator of two supersymmetry transformations is closed on all boson fileds without equations of motion. Other symmetry commutators of the theory are also calculated (α-symmetry and supersymmetry). The obtained Lagrangians are basic for the construction of those for six-dimentional chiral nonanomalous supergravities. 7 refs.

47579 **(IC—88/62) Connection of vector bundles over super Riemann surfaces.** Rakowski, M.; Thompson, G. (International Centre for Theoretical Physics, Trieste (Italy)). Mar 1988. 13p. NTIS (US Sales Only), PC A03/MF A01. Order Number DE88703844/JAW.

We establish a one to one correspondence between super-holomorphic structures on vector bundles over super Riemann surfaces and unitary connections satisfying certain curvature constraints. These curvature constraints are the canonical constraints used in superspace formulations of super Yang-Mills theories, but arise in our considerations as integrability requirements for the local existence of solutions to certain differential equations. Trivial line bundles are then considered, and it is shown that every superholomorphic structure on M x C/sup 1,0/ is equivalent to the superholomorphic structure of a flat unitary connection. Finally, we discuss the relationship of this work with some aspects of Witten's twistor-like transform. (author). 19 refs.

47580 **(IC—88/64) Note on the BFV-BRST operator quantization method.** Dayi, O.F. (International Centre for Theoretical Physics, Trieste (Italy)). Mar 1988. 14p. NTIS (US Sales Only), PC A03/MF A01. Order Number DE88703846/JAW.

The BFV-BRST operator quantization method is applied to massive, abelian (Yang-Mills) theory which has only second class constraints. A nilpotent BFV-BRST-charge is derived and used to define a unitarizing hamiltonian. Unphysical degrees of freedom can be eliminated either in a canonical gauge or in a relativistic one. In the latter gauge this is a general feature (at least locally) of the BFV-BRST quantization of the systems with irreducible constraints. (author). 23 refs.

47581 **(IC—88/70) On "spinning" membrane models.** Bergshoeff, E.; Sezgin, E.; Townsend, P.K. (International Centre for Theoretical Physics, Trieste (Italy); DAMPT, Cambridge (UK)). (International Centre for Theoretical Physics, Trieste (Italy)). Apr 1988. 10p. NTIS (US Sales Only), PC A02/MF A01. Order Number DE88703849/JAW.

Several alternative actions for a bosonic membrane have recently been proposed. We show that a linearly realized worldvolume-supersymmetric (spinning membrane) extension of any of these actions implies an analogous extension of the standard Dirac membrane action. We further show that a (Minkowski) spacetime Lorentz covariant spinning membrane action (that reduces to the Dirac membrane action when all fermions vanish) cannot be constructed within the framework of the three-dimensional super-Poincare tensor calculus. (author). 17 refs.

47582 **(IC—88/78) Ground state and supersymmetry of generally covariant systems.** Gamboa, J.; Zanelli, J. (International Centre for Theoretical Physics, Trieste (Italy)). Apr 1988. 31p. NTIS (US Sales Only), PC A03/MF A01. Order Number DE88703852/JAW.

We discuss the extension of Gozzi's approach to supersymmetry, based on the ground state representation (GSR) for quantum mechanical systems. The approach directly leads to the supersymmetric extensions of generally covariant systems, whose Hamiltonian constraints H=0 are naturally in their GSR form. The method is applied to several cases: relativistic particles interacting with external gauge and gravitational fields, strings, etc. (author). 31 refs.

47583 **(IC—88/79) Nature for gauge and Higgs fields.** Mola, R. (International Centre for Theoretical Physics, Trieste (Italy)). Apr 1988. 8p. NTIS (US Sales Only), PC A02/MF A01. Order Number DE88703853/JAW.

A new geometric model for Yang-Mills-Higgs-like fields is proposed on the group manifold. (author). 9 refs.

47584 **(IC—88/80) On the geometry for non-Abelian gauge fields.** Mola, R.; Pyzh, V.M. (International Centre for Theoretical Physics, Trieste (Italy); Kharkov Univ. (USSR). Dept. of Theoretical Physics). (International Centre for Theoretical Physics, Trieste (Italy)). Apr 1988. 9p. NTIS (US Sales Only), PC A02/MF A01. Order Number DE88703854/JAW.

A new geometric model for non-Abelian gauge fields on the group manifold is proposed. It is constructed on the basis of the gauge interpretation given to the geometry of the Lie group. It is proved that the Noether theorem follows from the geometry of the group manifold. (author). 12 refs.

47585 **(IC—88/88) Correlation functions in the N=2 superconformal field theory corresponding to a Calabi-Yau compactification.** Kei Ito. (International Centre for Theoretical Physics, Trieste (Italy)). May 1988. 6p. NTIS (US Sales Only), PC A02/MF A01. Order Number DE88703859/JAW.

The four-point correlation functions are calculated in the N=2 superconformal field theory corresponding to a Calabi-Yau compactification of the heterotic string theory. (author). 6 refs.

47586 **(NIKHEF-H—87-17) Rigid symmetries and BRST-invariance in gauge theories.** Holten, J.W. van. (Nationaal Inst. voor Kernfysica en Hoge-Energiefysica (NIKHEF), Amsterdam (Netherlands). Sectie H). Sep 1987. 6p. NTIS (US Sales Only), PC A02/MF A01. Order Number DE88703933/JAW.

The structure of the symmetry algebra of theories with simultaneous local and rigid symmetries is analyzed. BRST-invariant Faddeev-Popov gauge-fixing in such theories is discussed and it is proven, that the BRST-transformations can always be made to commute with the rigid symmetries by assigning specific transformation rules to the ghosts. The problem of keeping the rigid symmetries manifest in the quantum theory is shown to reduce to the problem of finding covariant gauge conditions. Such covariant

gauges exist only if the algebra of local and rigid symmetries has a semi-direct product structure. 9 refs.

47587 **Koba-Nielsen-Olesen scaling in string models.** Werner, K. (Physics Department, Brookhaven National Laboratory, Upton, New York 11973). *Physical Review Letters;* **61**: No. 9, 1050-1052(29 Aug 1988).

In certain string models for pp scattering the multiplicity distribution P(n) is given as a superposition $\int$ dm W(m)P(m,n) of contributions for a given string mass m. We demonstrate that Koba-Nielsen-Olesen (KNO) scaling follows as a consequence of a scaling property for the string-mass distribution W(m), thus relating the KNO scaling function psi to the quark structure functions, which determine W(m).

47588 **Evidence of ultraviolet divergence on the lattice.** Trivedi, A.K. (Enrico Fermi Institute and Department of Physics, University of Chicago, Chicago, Illinois 60637). *Physical Review Letters;* **61**: No. 8, 907-910(22 Aug 1988).

There is a widespread intuitive belief that lattice theories are automatically ultraviolet finite. It is shown here that this is false and that lattice theories are not immune from ultraviolet infinites. This is illustrated with an example. Causes, cures, and lessons are briefly noted.

47589 **Finiteness of lower-dimensional open-string theories.** Clavelli, L.; Cox, P.H.; Harms, B. (Department of Physics and Astronomy, University of Alabama, Tuscaloosa, Alabama 35406 and Department of Physics, Texas A&I University, Kingsville, Texas 78363). *Physical Review Letters;* **61**: No. 7, 787-790(15 Aug 1988).

We impose the requirement of one-loop finiteness on a class of recently proposed, lower-dimensional, open-string theories. It is shown that, unlike the apparent situation for closed-string theories, the finiteness requirement yields a unique lower-dimensional string.

47590 **Regularization dependence of the lattice Higgs-boson mass bound.** Bhanot, G.; Bitar, K. (Supercomputer Computations Research Institute, Florida State University, Tallahassee, Florida, 32306). *Physical Review Letters;* **61**: No. 7, 798-801(15 Aug 1988).

We numerically study the regularization dependence of the upper bound on the Higgs-particle mass M/sub H/(phys) by varying the lattice type and interaction. Computing f/sub π/ and λ/sub r/ where the scalar mass is $\sim$1, we find the bound M/sub H/(phys)$<$620 GeV. However, there is a small but systematic increase in the bound as the coordination number of the lattice increases. Hence, it is not meaningful to quote error estimates on such bounds.

47591 **Cosmological domain-wall problem in the $E_8 \times E_8$ superstring theory.** Holman, R.; Kephart, T.W.; Reiss, D.B. (Physics Department, Carnegie-Mellon University, Pittsburgh, Pennsylvania 15213). *Physical Review* [*Section*] *D: Particles and Fields;* **38**: No. 4, 1141-1143(15 Aug 1988).

We show that under some assumptions about the phase structure of the $E_8 \times E_8$ heterotic superstring, this theory will inevitably be afflicted with a cosmological domain-wall problem upon Calabi-Yau compactification (at or near the Planck scale). Several possible solutions are discussed, and we conclude that only inflation can resolve this problem. It thus becomes imperative, if we want to use this theory, to find an effective way to implement inflation in the superstring.

47592 **One-loop corrections to the four-graviton interaction in type-II superstring theory and heterotic string theory.** Meissner, K.A.; Pawel-dash-barczyk, J.; Pokorski, S. (Institute for Theoretical Physics, Warsaw University, 00-681 Warsaw, Poland). *Physical Review* [*Section*] *D: Particles and Fields;* **38**: No. 4, 1144-1149(15 Aug 1988).

Various one-loop corrections to the four-graviton interaction in type-II superstring theory and heterotic string theory are sorted out and some of them explicitly calculated. In particular, the leading correction for $\alpha' \to 0$ from the heterotic amplitude is obtained. Also the nonleading nonanalytic corrections are discussed and their correspondence to the one-loop supergravity diagrams is used for their classification.

47593 **Equivalence of Dirac-Kaehler and staggered lattice fermions in two dimensions.** Bodwin, G.T.; Kovacs, E.V. (High Energy Physics Division, Argonne National Laboratory, Argonne, Illinois 60439). *Physical Review* [*Section*] *D: Particles and Fields;* **38**: No. 4, 1206-1219(15 Aug 1988).

We discuss the Dirac-Kaehler and staggered formulations of lattice gauge theory with fermions and show that, although the noninteracting parts of the Lagrangians are identical, the Lagrangians differ in the interactions between the gauge field and the fermion field. However, we argue that, in general, the continuum limit of a two-dimensional gauge theory with fermions is independent of the precise details of the gauging of the fermion terms in the Lagrangian, provided that the resulting Lagrangian is invariant under an arbitrary infinitesimal gauge transformation. Hence, we conclude that, in two dimensions, the Dirac-Kaehler and staggered formulations are equivalent in the continuum limit. This equivalence is in agreement with explicit calculations of the axial-vector anomaly in the two formulations.

47594 **Tests of globally corrected hybrid updating.** Gausterer, H.; Sanielevici, S. (Physics Department, Brookhaven National Laboratory, Upton, New York 11973). *Physical Review* [*Section*] *D: Particles and Fields;* **38**: No. 4, 1220-1227(15 Aug 1988).

We test globally corrected hybrid updating algorithms for various lattice theories: a chain of coupled harmonic oscillators, pure SU(3) theory, and QCD with four flavors of dynamical staggered quarks. Systematic errors, acceptance, and time correlations are studied as functions of discretization step size, momentum refreshing frequency, volume, coupling and fermion-matrix-inversion residue.

47595 **Light-cone quantization on the lattice.** Mustaki, D. (Department of Physics, Boston University, Boston, Massachusetts 02215). *Physical Review* [*Section*] *D: Particles and Fields;* **38**: No. 4, 1260-1277(15 Aug 1988).

Field theories are regularized by discretization of the light-cone coordinates. As an example, the scalar-field quantization is carried out in detail, and the application to Monte Carlo computations is discussed.

47596 **Tuning the hybrid Monte Carlo algorithm.** Gupta, R.; Kilcup, G.W.; Sharpe, S.R. (Theoretical Division, Los Alamos National Laboratory, Los Alamos, New Mexico 87545). *Physical Review* [*Section*] *D: Particles and Fields;* **38**: No. 4, 1278-1287(15 Aug 1988).

We apply the hybrid Monte Carlo algorithm to pure gauge QCD and to QCD with four flavors of staggered dynamical fermions. We show how the acceptance in the global Metropolis step depends upon the parameters of the algorithm. By tuning the values of the coupling constants in the algorithm to be different from those in the global Metropolis step, we find that the acceptance can be kept large without having to make the step size prohibitively small. We give an analytic discussion of the tuning, and argue that the algorithm requires computer time growing proportional to V/sup 5/4/.

47597 **Finite-temperature transition for QCD with heavy quarks.** Gupta, R.; Kilcup, G.W.; Sharpe, S.R. (Theoretical Division, Los Alamos National Laboratory, Los Alamos, New Mexico 87545). *Physical Review* [*Section*] *D: Particles and Fields;* **38**: No. 4, 1288-1295(15 Aug 1988).

We use the hybrid Monte Carlo algorithm (HMCA) to simulate QCD with four flavors of staggered dynamical fermions on $6^3 \times 4$ and $8^3 \times 4$ lattices. We find evidence that the first-order finite-temperature transition found at small quark masses persists for m = 0.1, 0.2, 0.3, and 0.5. Our data strengthen the hypothesis that four-flavor QCD has a first-order finite-temperature transition for all quark masses.

47599 **New perturbative calculation of the fermion-boson mass ratio in a supersymmetric quantum field theory.** Bender, C.M.; Milton, K.A. (Department of Physics, Washington University, St. Louis, Missouri 63130). *Physical Review [Section] D: Particles and Fields;* **38**: No. 4, 1310-1314(15 Aug 1988).

We apply a recently proposed graphical perturbative calculational scheme to a two-dimensional supersymmetric model. Elsewhere, we reported the results of a second-order calculation of the ground-state energy density E in this model with the result that E = 0. Here, we calculate the boson-fermion mass ratio R to second order in this new perturbation theory. As in the previous calculation, there is a detailed cancellation between classes of graphs which leads to the unbroken supersymmetric result R = 1. .AE

47599 **Metropolis overrelaxation for lattice gauge theory for general relaxation parameter ω.** Adler, S.L. (The Institute for Advanced Study, Princeton, New Jersey 08540). *Physical Review [Section] D: Particles and Fields;* **38**: No. 4, 1349-1351(15 Aug 1988).

I give a Metropolis variant of the lattice-gauge-theory overrelaxation algorithm which I had suggested previously, with the following properties: (i) It satisfies detailed balance exactly with respect to the Wilson lattice action; (ii) it incorporates a general overrelaxation parameter ω; (iii) as the lattice spacing a approaches zero, the Metropolis acceptance approaches unity; and (iv) in the approximation that each link is effectively coupled to an average staple, the microcanonical (ω = 2) limit of the algorithm reduces to the lattice Metropolis algorithm of Creutz and Brown and Woch.

47600 **Deconfinement transitions in dual QCD.** Baker, M.; Ball, J.S.; Zachariasen, F. (Department of Physics, University of Washington, Seattle, Washington 98195). *Physical Review Letters;* **61**: No. 5, 521-524(1 Aug 1988).

The QCD Lagrangean expressed in terms of dual potentials exhibits, at zero temperature, spontaneous symmetry breaking giving rise to dual superconductivity and therefore to color confinement. At a finite temperature, the spontaneous symmetry breaking disappears and so does confinement. We estimate the deconfining transition temperature using a high-temperature expansion.

47601 **Physics of chiral Schwinger model: Taming an anomalous theory.** Boyanovsky, D.; Schmidt, I.; Golterman, M.F.L. (Department of Physics and Astronomy, University of Pittsburgh, Pittsburgh, Pennsylvania 15260). *Annals of Physics (New York);* **185**: No. 1, 111-137(Jul 1988).

We study the physical aspects of the chiral Schwinger model, comparing the content of this theory to that of the vector-like case. The theory is analyzed by bosonization with special attention to charged sectors and aspects of symmetry breaking. A generalized model with different left and right couplings is analyzed and the currents coupled to the gauge fields are shown to be conserved by using the equations of motion. The effects of the anomaly are studied and the mechanisms by which a new massless particle is introduced in the physical spectrum of the chiral model are clarified. We find that the longitudinal mode of the gauge field, acquiring dynamics because of the anomaly, is responsible for restoring the cluster property of chirality-carrying operators. The physics of the Wess-Zumino term is clarified and the equivalence between the theories with and without the Wess-Zumino term is spelled out. We construct the Hilbert spaces of the theories with and without the W-Z term and the physical subspaces are shown to be the same, with positive definite metric in both cases. The Ward identity $Z_2 = Z_1$ is shown to hold in the theory (without the W-Z term) despite its lack of local gauge invariance. copyright 1988 Academic Press, Inc.

47602 **Lattice regularization of quantum partition functions.** Furnstahl, R.J.; Serot, B.D. (Physics Department and Nuclear Theory Center, Indiana University, Bloomington, Indiana 47405). *Annals of Physics (New York);* **185**: No. 1, 138-169(Jul 1988).

The generating functional for thermal Green's functions is defined as the continuum limit of a path integral on a finite lattice. The path-integral measure arises naturally, and the correct limiting procedure is discussed. The generating functional is evaluated explicitly for noninteracting scalar and spinor fields, with particular attention to the measure and the overall normalization. The resulting expression contains a familiar piece, which involves the external sources and thermal propagators, multiplied by a normalization factor that is precisely the quantum partition function. The lattice dependence disappears in the final answer, and the partition function agrees with the canonical result multiplied by a term involving the zero-point energy. copyright 1988 Academic Press, Inc.

65 PHYSICS II

6510 Nuclear Physics

REFER ALSO TO CITATION(S) 47524, 47960

47803 **(GSI—88-02) GSI research and development program 1988 (including program budget).** (Gesellschaft fuer Schwerionenforschung m.b.H., Darmstadt (Germany, F.R.)). 1988. 62p. (In German). Gesellschaft fuer Schwerionenforschung m.b.H., Darmstadt (Germany, F.R.).

In this report the research and development program of the GSI Darmstadt (FRG) is described. It concerns the preparation of experiments at the SIS/ESR facility, the study of nuclear and atomic processes in heavy ion collisions at the UNILAC and external accelerators, and accelerator development. (HSI).

47804 **(Juel-Spez—403) KFA Juelich, Inst. of Nuclear Physics. Annual report 1986.** Gruemmer, F.; Kilian, K.; Schult, O.; Seyfarth, H.; Speth, H.; Turek, P. (eds.). (Kernforschungsanlage Juelich G.m.b.H. (Germany, F.R.). Inst. fuer Kernphysik). May 1987. 179p. Kernforschungsanlage Juelich G.m.b.H. (Germany, F.R.). Zentralbibliothek.

This annual report contains extended abstracts about the work performed at the named institute. This concerns nuclear reactions, theoretical and experimental studies on nuclear structure, intermediate energy physics, and development of accelerators, detectros, targets, spectrometers, and computers. (HSI).

47805 **(LBL—24580) Proceedings of the 8th high energy heavy ion study.** Harris, J.W. (ed.); Wozniak, G.J. (ed.). (Lawrence Berkeley Lab., CA (USA); Gesellschaft fuer Schwerionenforschung m.b.H., Darmstadt (Germany, F.R.)). Jan 1988. Contract AC03-76SF00098. 523p. (CONF-8711116—). NTIS, PC A23/MF A01; 1; GPO Dep. Order Number DE88014053/JAW.

From 8. high energy heavy ion study; Berkeley, CA, USA (16 Nov 1987).

This was the eighth in a series of conferences jointly sponsored by the Nuclear Science Division of LBL and the Gesellschaft fuer Schwerionenforschung in West Germany. Sixty papers on current research at both relativistic and intermediate energies are included in this report. Topics covered consisted of: Equation of State of Nuclear Matter, Pion and High Energy Gamma Emission, Theory of Multifragmentation, Intermediate Energies, Fragmentation, Atomic Physics, Nuclear Structure, Electromagnetic Processes, and New Facilities planned for SIS-ESR. The latest design parameters of the Bevalac Upgrade Proposal were reviewed for the user community. Also, the design of a new electronic 4π detector, a time projection chamber which would be placed at the HISS facility, was presented.

6511 Experimental Techniques

47606 **(N—88-23584) Computer program for parameterization of nucleus-nucleus electromagnetic dissociation cross sections.** Norbury, J.W.; Townsend, L.W.; Badavi, F.F. (National Aeronautics and Space Administration, Hampton, VA (USA). Langley Research Center). Jun 1988. 28p. (NASA-TM—4038; L—16427; NAS—1.15:4038). NTIS, PC A03/MF A01.

A computer subroutine parameterization of electromagnetic dissociation cross sections for nucleus-nucleus collisions is presented that is suitable for implementation in a heavy ion transport code.

The only inputs required are the projectile kinetic energy and the projectile and target charge and mass numbers.

6513 Nuclear Properties And Reactions, A=6-19, Experimental

47607 **(LA-UR—88-1787) Ratio of Gamow-Teller to Fermi strength observed in {sup 13,14}C(p,n) at 492 and 590 MeV.** Ullmann, J.L.; Rapaport, J.; Lisowski, P.W.; Byrd, R.C.; Carey, T.; Taddeucci, T.N.; McClelland, J.; Rybarcyk, L.; Haight, R.C.; King, N.S.P. (Los Alamos National Lab., NM (USA)). 1988. Contract W-7405-ENG-36. 7p. (CONF-880386—8). NTIS, PC A02/MF A01; 1; GPO Dep. Order Number DE88014470/JAW.

From International conference on spin-observables in nuclear physics; Telluride, CO, USA (14 Mar 1988).

It has been recognized for a number of years that certain spin-isospin components of the nucleon-nucleus effective interaction can be inferred from (p,n) reactions to states of known nuclear structure. For L = 0, S = 0 and L = 0, S = 1 transitions, the 0-degree (p,n) cross section can be related respectively to Fermi and Gamow-Teller beta decay matrix elements. If these transitions occur in the same nucleus, the ratio of isovector spin-flip to non-spin-flip effective interactions can be measured without regard for absolute normalization. The best reaction to measure this is {sup 14}C(p,n) which goes by a pure Gamow-Teller transition to the 1{sup {plus}} state at 3.95 MeV in {sup 14}N, and Fermi transition to the 2.31 MeV 0{sup {plus}} state. This work extends the ratio measurements made at lower energies (ref. 1, 2, 3) to 492 and 590 MeV. We also report on the {sup 13}C(p,n) reaction which goes by a pure GT transition to the 3.51 MeV 3/2{sup {minus}} state in {sup 13}N, but by a mixed Fermi plus Gamow-Teller transition to the 1/2{sup {minus}} ground state. 11 refs., 4 figs., 2 tabs.

47608 **Spin-dependent observables for the /sup 12/C(p,p'γ) reaction at 400 MeV.** Hicks, K.H.; Abegg, R.; Celler, A.; Haeusser, O.; Henderson, R.S.; Hill, N.W.; Jackson, K.P.; Jeppesen, R.G.; King, N.S.P.; Kovash, M.A.; and others. (TRIUMF, 4004 Wesbrook Mall, Vancouver, British Columbia, Canada V6Tchemical bond2A3). *Physical Review Letters;* **61**: No. 10, 1174-1177(5 Sep 1988).

Protons scattered inelastically from /sup 12/C were detected at laboratory angles between 6° and 13° in coincidence with γ rays from deexcitation of the 1^+ T = 1 state in the recoil nucleus. Coincident cross sections for γ rays emitted normal to the reaction plane and angular correlations for γ rays emitted in the proton scattering plane at angles between 90° and 270° are presented and compared with predictions from both nonrelativistic and relativistic models of proton-nucleus scattering calculated in the impulse approximation. These data display a clear preference for the relativistic-model prediction.

47609 **First observation of dielectron production in proton-nucleus collisions below 10 GeV.** Roche, G.; Claesson, G.; Hendrie, D.; Krebs, G.F.; Lallier, E.; Letessier-Selvon, A.; Matis, H.S.; Mulera, T.; Naudet, C.; Schroeder, L.; and others. (Lawrence Berkeley Laboratory, University of California, Berkeley, California 94720). *Physical Review Letters;* **61**: No. 9, 1069-1072(29 Aug 1988).

We have begun a program to measure dielectron production in p-nucleus and nucleus-nucleus collisions at the LBL Bevalac. Results are presented for the reaction p+Be at 4.9 GeV. For the first time, direct dilepton production is observed below 10 GeV incident energy. The cross sections are discussed and compared to previous data at higher energies. The observation of a structure at a mass of about 275 MeV suggests that pion annihilation may be the dominant production mechanism in this mass range.

6514 Nuclear Properties And Reactions, A=20-38, Experimental

47610 **Neutron-emission spectra and superdeformation in light nuclei.** Kolata, J.J.; Kryger, R.A.; DeYoung, P.A.; Prosser, F.W. (Physics Department, University of Notre Dame, Notre Dame, Indiana 46556). *Physical Review Letters;* **61**: No. 10, 1178-1181(5 Sep 1988).

Evidence is presented for the occurrence of superdeformation in sd-shell nuclei. Neutron-proton coincidence spectra from the /sup 16/O+/sup 12/C reaction at E/sub c.m./ = 24 MeV were measured. The neutron evaporation spectrum at low energies directly reflects the large deformation of the emitting system, extending to states above the yrast line. The strong energy dependence of the effect implies that the compound nucleus undergoes a rapid change from nearly spherical to superdeformed shapes over a narrow range of excitation energy. The transition to a fissioning system should be observable.

47611 **Pion double charge exchange to the double dipole resonance.** Mordechai, S.; Auerbach, N.; Burlein, M.; Fortune, H.T.; Greene, S.J.; Moore, C.F.; Morris, C.L.; O'Donnell, J.M.; Rawool, M.W.; Silk, J.D.; and others. (Ben-Gurion University of the Negev, Beer-Sheva 84105, Israel). *Physical Review Letters;* **61**: No. 5, 531-534(1 Aug 1988).

We report the first observation of a double isovector giant dipole state in nuclei (i.e., an isovector giant dipole resonance built on another giant dipole). Two new resonances were observed in (π^+,π^-) double charge exchange (at T/sub π/ = 292 MeV) on / sup nat/S at excitation energies of 24.7 and 28.7 MeV. The energy centroid is very close to the energy at which the double-dipole (J/sup π/ = $0^+,2^+$;T = 2) state is expected to appear. An angular distribution was measured for the resonances and observed to have a clear quadrupole shape. The measured cross sections and the angular distribution agree well with a simple sequential two-step calculation in which single charge exchange through the giant dipole resonance to the double dipole is evaluated.

6515 Nuclear Properties And Reactions, A=39-58, Experimental

47612 **Complete spin observables for quasielastic proton scattering from /sup 54/Fe at 290 MeV.** Haeusser, O.; Abegg, R.; Jeppesen, R.G.; Sawafta, R.; Celler, A.; Green, A.; Helmer, R.L.; Henderson, R.; Hicks, K.; Jackson, K.P.; and others. (TRIUMF, 4004 Wesbrook Mall, Vancouver, British Columbia, Canada V6Tchemical bond2A3). *Physical Review Letters;* **61**: No. 7, 822-825(15 Aug 1988).

Cross sections and a complete set of seven independent spin observables have been measured for inclusive quasielastic scattering of 290-MEV protons from /sup 54/Fe at a quasifree momentum transfer of 1.36 fm/sup -1/ and energy transfers varying from 0—90 MeV. Comparison of the results with relativistic and nonrelativistic impulse-approximation models shows that Fermi-motion averaging, a realistic nuclear response function, and medium modifications of the NN interaction are essential ingredients of a successful theory.

47613 **Electroexcitation of 8^- states in /sup 52/Cr.** Sober, D.I.; Fagg, L.W.; Zeidman, B.; Lawson, R.D.; Geesaman, D.F.; Morrison, G.C.; Karban, O.; Maruyama, X.K.; de Vries, H.; Offermann, E.A.J.M.; and others. (The Catholic University of America, Washington, D.C. 20064). *Physical Review* [*Section*] *C: Nuclear Physics;* **38**: No. 2, 654-663(Aug 1988).

Inelastic electron scattering at incident energies between 170 and 260 MeV was used to identify and study M8 transitions in /sup 52/Cr. A strong transition to an 8^- state at E/sub x/ = 15.47 MeV was observed, as well as a number of weaker transitions. The results are compared with a single particle-hole shell model calculation that uses a model space of the form [(f/sub 7/2/^{11} x g/sub 9/2/]$_8$/sub -/. The shell model calculation and systematics in neighboring nuclei were used to determine the isospin of the observed

states. The experimentally determined strengths exhaust 60.8% and 34.5% of the T = 3 and T = 2 sum rules, respectively.

6516 Nuclear Properties And Reactions, A=59-89, Experimental

47614 **(PNL-SA—16018) International germanium experiment (IGEX).** Avignone, F.T. III; Brodzinski, R.L.; Liles, C.D.; Miley, H.S.; Reeves, J.H.; Roberts, W.L.; Szady, A.J. (Pacific Northwest Lab., Richland, WA (USA)). May 1988. Contract AC06-76RL01830. 9p. (CONF-880173—6). NTIS, PC A02/MF A01; 1; GPO Dep. Order Number DE88014761/JAW.

From 22. Moriond workshop on neutrinos and exotic phenomena in particle physics and astrophysics; Les Arcs, France (23 Jan 1988).

Recent advances in isotopic enrichment technology now allow the enrichment of germanium to 85% ^{76}Ge in kilogram quantities using centrifuge techniques. The content of ^{70}Ge remaining will be negligibly small and that of ^{73}Ge will be reduced significantly. Recently completed experiments in ultralow-radioactivity-background techniques indicate that the dominant background remaining in the PNL/USC germanium spectrometer is due to ^{65}Zn, ^{68}Ge, and /sup 56,58/Co formed in reactions of cosmic-ray-generated fast neutrons on ^{70}Ge. The combination of isotopic enrichment and low-background fabrication technology should result in an improvement of two orders of magnitude over today's best efforts in searches for neutrinoless double-beta decay of ^{76}Ge. An international collaboration is being formed to build and operate a multikilogram enriched ^{76}Ge detector, housed in ultralow-background cryostats and shielding components, and located in an underground laboratory. 12 refs., 2 figs.

47615 **Shape coexistence effects and quasiparticle alignment in /sup 81/Sr.** Moore, E.F.; Cottle, P.D.; Gross, C.J.; Headly, D.M.; Huettmeier, U.J.; Tabor, S.L.; Nazarewicz, W. (Department of Physics, Florida State University, Tallahassee, Florida 32306). *Physical Review* [*Section*] *C: Nuclear Physics;* **38**: No. 2, 696-711(Aug 1988).

High spin states in /sup 81/Sr were investigated in the reactions /sup 56/Fe(/sup 28/Si,2pn) at 103.6 MeV and /sup 55/Mn(/sup 29/Si,p2n) at 95.2 MeV using the techniques of in-beam γ-ray spectroscopy. Measurements were made of γ-γ coincidences and γ-ray directional correlations from oriented nuclei. The lifetimes of 12 states and lifetime limits of 10 others were determined with the Doppler shift attenuation method. The data have been analyzed in terms of the Woods-Saxon cranking model. The first crossing observed in the yrast band is attributed to the alignment of a pair of g/sub 9/2/ protons. The irregularities observed in the J/sup (2)/ moment of inertia in the K/sup π/ = (5/2$^-$ and 1/2/sup (+)/ bands are interpreted as evidence for the alignment of a g/sub 9/2/ proton pair as well. The coexistence of prolate and oblate configurations at low spin is discussed in terms of the polarization of the soft even-even core by the odd neutron.

6517 Nuclear Properties And Reactions, A=90-149, Experimental

47616 **(INDC(GER)—31/GX) Angle and energy differential cross sections for the (p,xn) reactions of 25.6 MeV protons with 92,94,95,96,97,98,100/sub Mo/.** Mordhorst, E.; Trabandt, M.; Binasch, F.; Kaminsky, A.; Krause, H.; Langkau, R.; Scobel, W.; Strecker, M. (Hamburg Univ. (Germany, F.R.). 1. Inst. fuer Experimentalphysik). (International Atomic Energy Agency, Vienna (Austria). International Nuclear Data Committee). May 1988. 17p. NTIS (US Sales Only), PC A03/MF A01. Order Number DE88703865/JAW.

Cross sections for the inclusive production of neutrons from reactions of 25.6 MeV protons with all stable molybdenum isotopes have been measured with time-of-flight techniques for 24 angles ranging from 3 deg. to 177 deg. After a short presentation of the motivations for these measurements, the experimental set up is discussed with emphasis on the systematic and/or statistical uncertainties pertinent to this work. (author). 15 refs, 5 figs, 2 tabs.

47617 **(IYF-R—2-270) Investigation of the /sup 127/J(γ,n)/sup 126/J photonuclear reaction excitation function by means of SB-50 betatron bremsstrahlung.** Babadzhanov, R.D.; Ngo Nam Chinh; Aripov, G.; Kharisov, I.F.; Palvanov, S.R. (AN Uzbekskoj SSR, Tashkent. Inst. Yadernoj Fiziki). 1987. 14p. (In Russian). NTIS (US Sales Only), PC A03/MF A01. Order Number DE88703633/JAW.

Experimental relative yield curve of the reaction /sup 127/J(γ,n)/sup 126/J have been measured at bremsstrahlung of betatron SB-50 from their threshold up to 20 MeV. The differential cross sections and the integrate cross section have been calculated. The parameters of the giant resonances of the reaction /sup 127/J(γ,n)/sup 126/J have been determined: the resonance energy E/sub m/ =15.25 MeV, the width Γ=4.9 MeV, the integrate cross section σ/sup int/=1143.14 MeVxmb. 9 refs.; 6 figs.; 2 tabs.

47618 **Rare decays of cadmium and tellurium.** Mitchell, L.W.; Fisher, P.H. (Norman Bridge Laboratory of Physics, California Institute of Technology, Pasadena, California 91125). *Physical Review* [*Section*] *C: Nuclear Physics;* **38**: No. 2, 895-899(Aug 1988).

We report on the pulse height spectrum observed with a CdTe detector in a low-background shield. The spectrum is dominated by the T/sub 1/2/~10/sup 16/ yr β^- decay of /sup 113/Cd. Limits are set on the double beta decay of the isotopes /sup 106,114,116/Cd and /sup 128,130/Te, and the prospects for a more sensitive search for this mode of decay are discussed.

47619 **Superdeformation in /sup 104,105/Pd.** Macchiavelli, A.O.; Burde, J.; Diamond, R.M.; Beausang, C.W.; Deleplanque, M.A.; McDonald, R.J.; Stephens, F.S.; Draper, J.E. (Nuclear Science Division, Lawrence Berkeley Laboratory, Berkeley, California 94720). *Physical Review* [*Section*] *C: Nuclear Physics;* **38**: No. 2, 1088-1091(Aug 1988).

In the present Rapid Communication, we report the discovery of a rotational band in /sup 105/Pd and possibly one in /sup 104/Pd that can be interpreted as arising from superdeformed shapes. The moments of inertia, J/sup (1)/ and J/sup (2)/, of these bands are similar to those measured in the Ce—Nd region, once the A/sup 5/3/ mass dependence is removed. This implies a deformation ϵ~0.35—0.4. If so, this is the third mass region where superdeformed bands have been found at high spins.

6518 Nuclear Properties And Reactions, A=150-189, Experimental

47620 **Nuclear data sheets for A = 178.** Browne, E. (Lawrence Berkeley Laboratory, Berkeley, California 94720, USA). *Nuclear Data Sheets;* **54**: No. 2, 199-306(Jun 1988).

Spectroscopic data for all nuclei with mass number A = 178 have been evaluated, and the corresponding level schemes from radioactive decay and reaction studies are presented. This evaluation for A = 178 supersedes the earlier one by L. R. Greenwood (74Gr45), published in Nuclear Data Sheets 13, 549 (1974). copyright 1988 Academic Press, Inc.

47621 **Nuclear data sheets for A = 182.** Firestone, R.B. (Lawrence Berkeley Laboratory, Berkeley, California 94720, USA). *Nuclear Data Sheets;* **54**: No. 2, 307-407(Jun 1988).

Spectroscopic data for all nuclei with mass number A = 182 have been evaluated, and the corresponding level schemes from radioactive decay and reaction studies are presented. copyright 1988 Academic Press, Inc.

6519 Nuclear Properties And Reactions, A=190-219, Experimental

47622 **(CERN/EP—87-181) Laser spectroscopy in the Z < 82 region.** Becker, S.; Gerber, M.; Hilberath, T.; Kluge, H.J.; Kroenert, U.; Wallmeroth, K. (European Organization for Nuclear Research, Geneva (Switzerland)). 30 Sep 1987. 5p. (CONF-870970—16). NTIS (US Sales Only), PC A02; 1; GPO Dep. Order Number DE88012599/JAW.

From 5. international conference on nuclei far from stability; Lake Rosseau, Canada (14 Sep 1987).

The nuclei with Z < 82 and N ≈ 104 have attracted considerable attention during the last years following the observation of a sudden change of the nuclear deformation in the light Hg isotopes by optical spectroscopy. In the meantime systematic measurements have been performed in the mass range 181 ≤ A ≤ 06. An update of the existing information has been published recently. Similar data on properties of nuclear ground and isomeric states of neighbouring elements are of interest in order to study the influence of pairing and shell effects. Hence we started a program to investigate neutron-deficient Au isotopes at the on-line isotope separator ISOLDE/CERN. 9 refs., 3 figs.

47623 **(INIS-mf—11285) Limitations of the mean-field description for nuclei in the Pb-region, observed with the (e,e'p) reaction.** Quint, E.N.M. (Amsterdam Univ. (Netherlands)). 15 Mar 1988. 153p. NTIS (US Sales Only), PC A08/MF A01. Order Number DE88703905/JAW.

Contains summary in Dutch.

The aim of the high-resolution electron induced quasi-elastic proton knockout experiments is to determine absolute occupation numbers for the valence-proton orbits of /sup 208/Pb and to check whether the predicted occupancies of 70 to 80% can be experimentally verified or that the general trend of the much lower spectroscopic factors observed in the lighter nuclei continues. Therefore the spectral function of /sup 208/Pb is mapped out with the (e,e'p) reaction in a missing-momentum range between -50 and 300 MeV/c. The spectroscopic factors for the known discrete hole states in /sup 207/Tl at excitation energies of 0.0 (1/2/sup +/), 0.35 (3/2/sup +/), 1.35 (11/2/sup -/), 1.67 (5/2/sup +/) and 3.48 MeV (7/2/sup +/) are determined by comparison with calculated (CDWIA) momentum densities and an l-decomposition is performed for the continuum. Since rather small spectroscopic factors were expected and bearing in mind the large implications for the theory, an additional calibration of the spectroscopic factors deduced from the (e,e'p) data was needed. Such a calibration possibility was found for the 3s/sub 1/2/ proton orbit in /sup 208/Pb, which according to the shell-model picture is just filled. Two relative (e,e'p) experiments were performed on the pairs /sup 205/Tl//sup 206/Pb and /sup 206/Pb//sup 208/Pb which allowed the determination of the absolute 3s/sub 1/2/ proton occupation in /sup 205/Tl, /sup 206/Pb and /sup 208/Pb. 47 refs.; 23 tabs.

47624 **Stripping- and pickup-induced breakup in 11- and 17-MeV/nucleon /sup 20/Ne+/sup 197/Au reactions.** Gazes, S.B.; Schmidt, H.R.; Chan, Y.; Chavez, E.; Kamermans, R.; Stokstad, R.G. (Nuclear Science Division, Lawrence Berkeley Laboratory, University of California, Berkeley, California 94720). *Physical Review [Section] C: Nuclear Physics;* **38**: No. 2, 712-727(Aug 1988).

Breakup processes in 220- and 341-MeV /sup 20/Ne+/sup 197/Au reactions were studied by performing coincidence measurements of the secondary fragments. Projectile-like fragments and light charged particles corresponding to primary stripping, pickup, and inelastic channels were examined. The projectile-like fragments were detected near the classical grazing angle. Kinematic reconstructions of the three-body final states were used to deduce the excitations in the primary projectile-like and target-like fragments. At both bombarding energies, the stripping channels produced relatively cold ejectiles, with the excitation residing mostly in the target recoil. However, the pickup channels tended to leave the target cold, while populating higher excitations in the ejectile. The data are consistent with nucleon transfer as the dominant mode for generating excitation, with the partition of excitation energy between the fragments governed by the direction of the transfer. An extended version of the optimum-Q-value model of Siemens et al. predicts target-like excitations in good agreement with data at 11 MeV/nucleon, but with deviations occurring at 17 MeV/nucleon.

6520 Nuclear Properties And Reactions, A=220 And Above, Experimental

47625 **(ITEF—200(1987)) Investigation of energy dependence of P-odd fragment escape asymmetry in /sup 233/U and /sup 235/U fission by polarized neutrons.** Beda, A.G.; Vodennikov, B.D.; Danilyan, G.V. (Gosudarstvennyj Komitet po Ispol'zovaniyu Atomnoj Ehnergii SSSR, Moscow. Inst. Teoreticheskoj i Ehksperimental'noj Fiziki). 1987. 9p. (In Russian). NTIS (US Sales Only), PC A02/MF A01. Order Number DE88703612/JAW.

Energy dependence of P-odd fragment escape asymmetry in /sup 233/U and /sup 235/U fission monochromatic polarized neutrons is investigated in (0.009-0.3) eV neutron energy interval. In case of /sup 233/U the effect of sign change is observed in 0.15 eV range. In case of /sup 235/U no dependence of the investigated P-odd asymmetry on neutron energy, including fission, is found within the experiment accuracy limits. Model analysis of the results obtained is conducted. 5 refs.; 3 figs.

47626 **(IYF-R—2-278) Effect of fission product internal conversion on degree of their ionization.** Belyaev, A.D.; Bikbova, Z.S.; Gajshan, V.L. (AN Uzbekskoj SSR, Tashkent. Inst. Yadernoj Fiziki). 1987. 8p. (In Russian). NTIS (US Sales Only), PC A02/MF A01. Order Number DE88703634/JAW.

Experimental study of distribution fine structure on ionization degree of a heavy group (A=131-145) separated by mass of /sup 241/Pu fission products at three values of kinetic energy, i.e. E/sub k/=67, 70 and 73 MeV. Their structure smoothing and the separation of atomic and nuclear ionization effects of fission products was performed by their additional recharging in t <5x10/sup -10/ s after fission. It has been shown that the contribution of the nuclear effect of ionization depends on excitation energy of fission products and their nuclear structure attaining ~ 50% for certain masses. Experimental proofs of the essential role of nuclear transition internal conversion of fission products in the formation of their electron shell have been obtained. 8 refs.; 3 figs.; 1 tab.

47627 **(JINR—R-3-87-718) Variations of the gamma-quanta yields in the /sup 235/U fission induced by resonance neutrons.** Gundorin, N.A.; Duka-Zojomi, A.; Kliman, Ya.; Furman, V.I. (Joint Inst. for Nuclear Research, Dubna (USSR). Lab. of Neutron Physics). 1987. 6p. (In Russian). NTIS (US Sales Only), PC A02/MF A01. Order Number DE88703744/JAW.

New experimental results on the prompt gamma-ray yields from /sup 95/Sr, /sup 100,102/Zr and /sup 142,144,146/Ba fission fragment of the /sup 235/U fission by resonance neutrons for the energy range between 0.5 and 36 eV are given. The method of prompt gamma spectrometry with fixed neutron energy by time-of-flight was used. Variations the gamma-ray yields in the /sup 236/U compound nucleus resonances are correlated with fragment angular anisotropy coefficients, the peak to valley ratio in mass distribution, average kinetic energies and statistics of the fission widths. The significant multiple correlations between these values have been found for 23 resolved resonances at J/sup π/=4/sup -/ spin states. Besides, it is observed that each characteristics under study is correlated with a contributions to the given resonance of the specific fission channels with J/sup π/K=4/sup -/,1 and J/sup π/K=4/sup -/,2 states. The observed correlations demonstrate that the main characteristics of the fission fragments in individual resonances are determined by the properties of the vibration fission states with the fixed J/sup π/K values, while their admixture is randomly changed from resonance to resonance. 7 refs.; 6 figs.

47628 (KIYI—87-9) Inelastic scattering of 144 keV neutrons by thorium-232. Litvinskij, L.L.; Vertebnyj, V.P.; Libman, V.A.; Murzin, A.V. (AN Ukrainskoj SSR, Kiev. Inst. Yadernykh Issledovanij). 1987. 6p. (In Russian). NTIS (US Sales Only), PC A02/MF A01. Order Number DE88703794/JAW.

Total and differential neutron elastic and inelastic (at the 2/ sup +/, 49 keV level) scattering cross sections and total neutron cross-section of thorium-232 have been measured at 144 keV neutron energy at the WWR-M atomic reactor of the Institute for Nuclear research of the AS Uk.SSR, Ro/sup ∞/, R/sub 1//sup ∞/R/ sub 2//sup ∞/ potential scattering parameters and S/sub 1/ p-wave strength function of thorium-232 have been obtained from the neutron cross-section analysis. 8 refs.; 1 tab.

47629 (LA-UR—88-1813) Neutron induced fission cross section ratios for ^{232}Th, /sup 235,238/U, ^{237}Np, and ^{239}Pu from 1 to 400 MeV. Lisowski, P.W.; Ullmann, J.L.; Balestrini, S.J.; Carlson, A.D.; Wasson, O.A.; Hill, N.W. (Los Alamos National Lab., NM (USA); National Bureau of Standards, Washington, DC (USA); Oak Ridge National Lab., TN (USA)). 1988. Contract W-7405-ENG-36. 4p. (CONF-880546—31). NTIS, PC A02/MF A01; 1; GPO Dep. Order Number DE88014460/JAW.

From International conference on nuclear data for science and technology; Mito, Japan (30 May 1988).

Time-of-flight measurements of neutron induced fission cross section ratios for ^{232}Th, /sup 235,238/U, ^{237}Np, and ^{239}Pu, were performed using the WNR high intensity spallation neutron source located at Los Alamos National Laboratory. A multiple-plate gas ionization chamber located at a 20-m flight path was used to simultaneously measure the fission rate for all samples over the energy range from 1 to 400 MeV. Because the measurements were made with nearly identical neutron fluxes, we were able to cancel many systematic uncertainties present in previous measurements. This allows us to resolve discrepancies among different data sets. In addition, these are the first neutron-induced fission cross section values for most of the nuclei at energies above 30 MeV. 8 refs., 3 figs.

6530 Nuclear Theory

REFER ALSO TO CITATION(S) 47445, 47490, 47534, 47551, 47613

47630 (BNL-NCS—41381) Half-lives for selected actinides and long-lived radionuclides. Holden, N.E. (Brookhaven National Lab., Upton, NY (USA)). 1988. Contract AC02-76CH00016. 4p. (CONF-880546—23). NTIS, PC A02/MF A01; 1; GPO Dep. Order Number DE88012521/JAW.

From International conference on nuclear data for science and technology; Mito, Japan (30 May 1988).

Long-lived actinide nuclides are of interest for their use in nuclear reactors, for nuclear reactor burnup studies in waste management, and for safeguard applications, e.g., α counting is used to determine the amount of material present. Some long-lived radionuclides are of interest for their use in determining geological ages using various dating methods, and in calculating the cosmic-ray exposure ages of meteorites. Recommended values are presented for both the total half-life and for the spontaneous fission half-life of / sup 232-236,238/U, of /sup 236,238-242,244/Pu, of /sup 241,242m,243/Am, and of /sup 242-248,250/Cm. Problems with the presentation of uncertainties are discussed. The impact of the revised ^{14}C half-life on the carbon dating technique and various ^{14}C ages is discussed. The possible primordial occurrence of ^{92}Nb is now definitely ruled out. Based on examination of the ^{26}Al half-life, the calculated value for the cosmic-ray exposure age of meteorites remains too high compared to the age calculated using other radionuclide half-life values. ^{204}Pb, which was once thought to be radioactive, is shown to be stable. 37 refs., 5 tabs.

47631 (BNL-NCS—52155) An intercomparison of medium energy cross-section codes. Pearlstein, S. (Brookhaven National Lab., Upton, NY (USA)). May 1988. Contract AC02-76CH00016. 48p. NTIS, PC A04/MF A01; 1; GPO Dep. Order Number DE88014689/JAW.

Five medium energy proton reaction cases are selected for benchmarking nuclear model codes. The quantities calculated are isotopic activation yields for 180 MeV protons on Al and 40-200 MeV protons on Co, and double differential neutron emission spectra from Al, Zr-90 and Pb-208 for 35, 80, 160, 318, and 800 presented consist of three types: a closed form preequilibrium plus evaporation model, an intranuclear-cascade and evaporation model, and a model relying on nuclear systematics. The characteristics of each code are described. There are orders of magnitude differences in the time for each type of code to calculate neutron emission spectra, with codes using systematics, preequilibrium and intranuclear-cascade models requiring seconds, minutes and hours, respectively. Calculations are not compared with experiment in this initial study. For double differential neutron emission spectra, there is good overall agreement in magnitude among the different types of codes at forward angles. Differences where they occur at forward angles are greatest for the mid-energy neutrons emitted. At back angles the incident energy at which the best overall agreement is obtained is 160 MeV and the material for which the best overall agreement is obtained is Al. 4 refs., 7 tabs.

47632 (DOE/ER/40387—T1) Study of structure of nuclei with neutrons and nuclear data measurements for MFE: Progress report, 1 December 1987-31 July 1988. Lane, R.O.; Grimes, S.M.; Knox, H.D. (Ohio Univ., Athens (USA)). 1988. Contract FG02-88ER40387. 86p. NTIS, PC A05/MF A01; 1; GPO Dep. Order Number DE88013751/JAW.

Measurement and analysis of cross sections for neutron induced reactions of interest to the fusion energy program have been carried out. Studies have included the neutron induced reactions of ^{9}Be, ^{10}B, ^{13}C and ^{13}C. The (n,xp) and (n,xα) reactions have been investigated for ^{54}Fe and ^{56}Fe. Data from these studies have been analyzed using either R{endash}matrix studies, combined R{endash}matrix and shell model calculations or Hauser{endash}Feshbach calculations. Details of measurements and theoretical studies are given. New electronic developments to assist in neutron detection over a large dynamic range as well as new developments in proportional counters are discussed.

47633 (ECN—205) Recent developments in exciton and unified models. Gruppelaar, H.; Akkermans, J.M. (Netherlands Energy Research Foundation, Petten). Apr 1988. 38p. NTIS (US Sales Only), PC A03/MF A01. Order Number DE88703814/JAW.

Recent developments of the exciton model in its master-equation formulation are reviewed. Progress has been made in the modelling and the calculation of angular distributions, gamma-ray emission, particle-hole level densities, preformation factors for complex particle emission and two-fermion models. The most interesting development, however, is the integration of precompound and compound models by including angular-momentum conservation. At present this unified model is successful in predicting angle-integrated quantities. It is essentially equivalent to the quantal multistep compound models, but it has some computational advantages. Possibilities are discussed for further integration of precompound and compound models on a quantum-mechanical basis and some directions for future work are suggested. 8 figs.; 49 refs.

47634 (IC—88/47) Thermostatic properties of semi-infinite polarized nuclear matter. Abd-Alla, M.; Hassan, M.Y.M.; Ramadan, S. (Cairo Univ., Giza (Egypt). Physics Dept.). (International Centre for Theoretical Physics, Trieste (Italy)). Mar 1988. 41p. NTIS (US Sales Only), PC A03/MF A01. Order Number DE88703842/JAW.

The surface and curvature properties of semi-infinite polarized nuclear matter (SPNM) are calculated using an expansion for the Fermi integrals up to T/sup 2/. A density matrix expansion is obtained for a modified form of Seylcr-Blanchard interaction. New parameters that characterize the surface and curvature properties of SPNM are introduced. The level density parameter is extracted from the low temperature expansion of the free energy and compared with previous calculations. A reasonable agreement is obtained for the parameters calculate1 before. (author). 78 refs, 1 fig., 5 tabs.

47635 (INDC(HUN)—025/L) Analysis of the /sup 27/Al(n,t)/sup 25/Mg excitation function. Ignatyuk, A.V.; Grudzevich, O.T.; Mihaly, K.; Boedy, Z.T. (Gosudarstvennyj Komitet po Ispol'zovaniyu Atomnoj Ehnergii SSSR, Obninsk. Fiziko-Ehnergeticheskij Inst.; Budapesti Mueszaki Egyetem (Hungary). Egyetemi Reaktor; Kossuth Lajos Tudomanyegyetem, Debrecen (Hungary). Kiserleti Fizikai Intezet). (International Atomic Energy Agency, Vienna (Austria). International Nuclear Data Committee). Jan 1988. 9p. NTIS (US Sales Only), PC A02/MF A01. Order Number DE88703866/JAW.

The excitation functions for the reactions /sup 27/Al(n,t)/sup 25/Mg and /sup 27/Al(n,α)/sup 24/Na are calculated using revised level density parameters taking into account the role of the concurrent reaction channels. 11 refs, 2 figs.

47636 (ITEF—81(1987)) Statistical simulation of excited nucleus fission. 1. Formulation of model. Stepanov, N.V. (Gosudarstvennyj Komitet po Ispol'zovaniyu Atomnoj Ehnergii SSSR, Moscow. Inst. Teoreticheskoj i Ehksperimental'noj Fiziki). 1987. 21p. (In Russian). NTIS (US Sales Only), PC A03/MF A01. Order Number DE88703595/JAW.

A fission channel, based on thermodynamical fission model, has been added to the intranuclear-cascade-evaporation ITEP program. The calculated mass spectra and fission cross sections of /sup 208/U and /sup 209/Bi by neutrons and protons are in reasonable agreement with experimental data. 33 refs.; 4 figs.

47637 (ITF—87-41) Fragmentation of the /sup 3/He nuclei into deuterons at high energies. Anchishkin, D.V.; Kobushkin, A.P. (AN Ukrainskoj SSR, Kiev. Inst. Teoreticheskoj Fiziki). 1987. 21p. (In Russian). NTIS (US Sales Only), PC A03/MF A01. Order Number DE88703630/JAW.

The fragmentation of /sup 3/He nuclei by nuclei into deuterons escaping at small angles is considered. The three nucleon wave function is relativized. The differential cross-section of the process is calculated and compared with experimental data measured in Dubna at p/sub (sup 3)He/=10.8 GeV/s. 26 refs.; 6 figs.

47638 (IYF-R—1-286) Quadrupole radiative widths in deformed nuclei. Begzhanov, R.B.; Meliev, F.M. (AN Uzbekskoj SSR, Tashkent. Inst. Yadernoj Fiziki). 1987. 8p. (In Russian). NTIS (US Sales Only), PC A02/MF A01. Order Number DE88703928/JAW.

Within the quasiparticle-phonon model of nuclei the reduced widths of quadrupole radiative transitions and ratio of partial widths Γ/sub E1//Γ/sub E2/ with the weighting function of second order are calculated. Calculated values of K/sub E2/ and Γ/sub E1//Γ/sub E2/ for /sup 156/Gd, /sup 158/Gd and /sup 168/Er deformed even-even nuclei are in qualitative agreement with the available experimental data. 16 refs.; 1 tab.

47639 (JINR—E-4-87-409) Description of the mass and kinetic-energy distributions of fission fragments using an adiabatic potential. Saupe, G.; Serdiuk, O.I.; Adeev, G.D.; Pashkevich, V.V. (Joint Inst. for Nuclear Research, Dubna (USSR). Lab. of Theoretical Physics). 1987. 12p. NTIS (US Sales Only), PC A03/MF A01. Order Number DE88703690/JAW.

Submitted to the journal Sov. J. Nucl. Phys. .

The mass distributions of fission fragments from rotating composite nuclear systems with parameters Z/sup 2//A > 40 have been calculated in the framework of the diffusion model based on the Fokker-Planck equation for the distribution function of the collective variables. In this formalism the two-body nuclear viscosity coefficient describing the intensity of the dissipative forces is the only free parameter. It has been found that the consideration of the angular momenta of the fissile nuclei leads to a small increase in the calculated widths which slightly improves the agreement with the experimental data. In addition, the fission fragment kinetic-energy distributions have been calculated and compared with the measured ones. 24 refs.; 6 figs.

47640 (LA-UR—88-1925) Improved calculation of the prompt fission neutron spectrum from the spontaneous fission of {sup 252}Cf: Preliminary results. Madland, D.G. (Los Alamos National Lab., NM (USA)). 1988. Contract W-7405-ENG-36. 5p. (CONF-880546—28). NTIS, PC A02/MF A01; 1; GPO Dep. Order Number DE88014447/JAW.

From International conference on nuclear data for science and technology; Mito, Japan (30 May 1988).

An improved calculation is presented for the prompt fission neutron spectrum N(E) from the spontaneous fission of {sup 252}Cf. In this calculation the fission-spectrum model of Madland and Nix is used, but with several improvements leading to a physically more accurate representation of the spectrum. Specifically, the contributions to N(E) from the entire fission-fragment mass and charge distributions will be calculated instead of calculating on the basis of a seven- point approximation to the peaks of these distributions as has been done in the past. Therefore, values of the energy release in fission, fission-fragment kinetic energy, and compound nucleus cross section for the inverse process will be considered on a point-by-point basis over the fragment yield distributions instead of considering averages of these quantities over the peaks of the distributions. Preliminary results will be presented and compared with a measurement, an earlier calculation, and a recent evaluation of the spectrum. 14 refs., 4 figs.

47641 (LA-UR—88-2084) The Kemmer-Duffin-Petiau formalism and intermediate-energy deuteron-nucleus scattering. Kozack, R.E.; Clark, B.C.; Hama, S.; Mishra, V.K.; Kaelbermann, G.; Mercer, R.L.; Ray, L. (Los Alamos National Lab., NM (USA)). 1988. Contract W-7405-ENG-48;AS05-80ER10638. 9p. (CONF-8806130—2). NTIS, PC A02/MF A01; 1; GPO Dep. Order Number DE88014416/JAW.

From Relativistic nuclear many-body physics conference; Columbus, OH, USA (6 Jun 1988).

The spin-1 Kemmer-Duffin-Petiau (KDP) equations are described and applied to deuteron-nucleus scattering. Comparison with d + ^{58}Ni elastic scattering data at 400 MeV shows that the KDP model; reproduces experimental spin observables very well. 11 refs., 1 fig.

47642 (LA-UR—88-2296) Probing two-nucleon correlations with pion double-charge exchange. Baer, H.W. (Los Alamos National Lab., NM (USA)). 1988. Contract W-7405-ENG-36. 13p. (CONF-8805142—13). NTIS, PC A03/MF A01; 1; GPO Dep. Order Number DE88014329/JAW.

From 3. international conference on the intersections between particle and nuclear physics; Rockport, ME, USA (14 May 1988).

A review is given of pion double-charge reactions at incident energies of 30 to 65 MeV and leading to isobaric-analog states. The large effects on cross section magnitudes and angular-distribution shapes produced by two-nucleon correlations are discussed. New results on 1 f{sub 7/2} shell nuclei are compared to predictions of a shell-model-based two-amplitude model. 19 refs., 15 figs., 2 tabs.

47643 (LA-UR—88-2380) Calculated neutron-activation cross sections for E{sub n} {le} 100 MeV for a range of accelerator materials. Bozoian, M.; Arthur, E.D.; Perry, R.T.; Wilson, W.B.; Young, P.G. (Los Alamos National Lab., NM (USA)). 1988. Contract W-7405-ENG-36. 6p. (CONF-880546—33). NTIS, PC A02/MF A01; 1; GPO Dep. Order Number DE88014336/JAW.

From International conference on nuclear data for science and technology; Mito, Japan (30 May 1988).

Activation problems associated with particle accelerators are commonly dominated by reactions of secondary neutrons produced in reactions of beam particles with accelerator or beam stop materials. Measured values of neutron-activation cross sections above a few MeV are sparse. Calculations with the GNASH code have been made for neutrons incident on all stable nuclides of a range of elements common to accelerator materials. These elements include B, C, N, O, Ne, Mg, Al, Si, P, S, Ar, K, Ca, Cr, Mn, Fe, Co, Ni, Cu, Zn, Zr, Mo, Nd, and Sm. Calculations were made for a grid of incident neutron energies extending to 100 MeV. Cross sections

leading to the direct production of as many as 87 activation products for each of 84 target nuclide were tabulated on this grid of neutron energies, each beginning with the threshold for the product nuclide's formation. Multigrouped values of these cross sections have been calculated and are being integrated into the cross-section library of the REAC-2 neutron activation code. Illustrative cross sections are presented. 20 refs., 6 figs., 1 tab.

47644 **Single-channel dominance of p-p inelasticity near 1 GeV: Parametrizing spin-coupled waves.** Arndt, R.A. (Department of Physics, Virginia Polytechnic Institute and State University, Blacksburg, Virginia 24061). *Physical Review Letters;* 61: No. 5, 529-530(1 Aug 1988).

chi^2 mappings in the necessary, but generally unsearched, sixth parameter of the $^3P_2$-$^3F_2$ N-N partial wave around 1 GeV reveal a strong preference for single-channel dominance of the inelasticity. This is consistent with the constraint imposed by fixing the sixth parameter in the VPI analyses but it is contrary to the hidden constraint imposed upon all other analyses of nucleon-nucleon elastic scattering.

47645 **Model dependence of charge-symmetry breaking in the neutron-proton interaction.** Beyer, M.; Williams, A.G. (Paul Scherrer Institute, CH-5234 Villigen, Switzerland). *Physical Review* [*Section*] *C: Nuclear Physics;* 38: No. 2, 779-786(Aug 1988).

The effects of charge-symmetry breaking of nuclear forces can be observed in neutron-proton elastic scattering as a difference between neutron and proton analyzing powers. A formalism has previously been developed and applied to compute these effects in terms of electromagnetic interactions, one-boson exchange potentials, the two-pion exchange potential, and possible quark effects. The results were found to be in agreement with the one existing measurement. Here we extend this work and study in detail how these charge-symmetry breaking predictions vary with the particular choice for the nucleon-nucleon force. We compare predictions for Reid soft-core, Paris, coordinate-space Bonn, and hybrid quark-meson potentials. We show in particular that charge-symmetry breaking measurements can place strong restrictions on models of the nucleon-nucleon interaction.

47646 **(γ,pp-bar) as a probe of the Dirac negative energy bound states.** Jin, Y.; Onley, D.S. (Department of Physics and Astronomy, Ohio University, Athens, Ohio 45701). *Physical Review* [*Section*] *C: Nuclear Physics;* 38: No. 2, 813-817(Aug 1988).

The relativistic nuclear shell model with large scalar and time-component vector potentials predicts very strongly bound negative-sea states. Such states may be absent in alternative versions of the model which contains a tensor term. The process (γ,pp-bar) in the presence of a nucleus could form a highly excited p-bar-nucleus with gamma ray energy less than 2M. The predicted cross section for γ+/sup 16/O→/sub <1//sub p-bar/^{5}N+p has a threshold 1.2 GeV and rises to about 5 μb by 1.6 GeV.

47647 **/sup 14/C beta decay and the /sup 14/N M1 form factors.** Jin, Y.; Wright, L.E.; Bennhold, C.; Onley, D.S. (Department of Physics and Astronomy, Ohio University, Athens, Ohio 45701). *Physical Review* [*Section*] *C: Nuclear Physics;* 38: No. 2, 923-930(Aug 1988).

The description of p-shell orbitals in the A = 14 nuclear system in terms of relativistic wave functions, which are solutions to the Dirac equation with strong scalar and vector potentials, provides a good description of the M1 form factors in /sup 14/N and the greatly suppressed /sup 14/C beta decay rate.

47648 **Pairing, temperature, and deformed-shell effects on the properties of superdeformed /sup 152/Dy nucleus.** Dudek, J.; Herskind, B.; Nazarewicz, W.; Szymanski, Z.; Werner, T.R. (Joint Institute for Heavy Ion Research, Oak Ridge, Tennessee 37831). *Physical Review* [*Section*] *C: Nuclear Physics;* 38: No. 2, 940-952(Aug 1988).

The existence of superdeformed shell closures together with pairing and the nuclear temperature effects are shown to explain the originally unexpected properties of the superdeformed band observed up to I~60(h/2π) in the /sup 152/Dy nucleus. No parameters were adjusted to the superdeformed band properties. Population, and depopulation of the superdeformed bands, the moments of inertia, and side feeding properties are discussed and qualitatively understood. The use of the free-energy calculation results and the microcanonical ensemble formulation of the level-density problem at high-spin are proposed and discussed.

47649 **Nature of the equivalence between gamma instability and rigid triaxiality for finite boson number.** Cohen, T.D. (Department of Physics and Astronomy, University of Maryland, College Park, Maryland 20742). *Physical Review* [*Section*] *C: Nuclear Physics;* 38: No. 2, 1038-1045(Aug 1988).

Recently, it was observed that the O(6) limit of the interacting boson model for moderate boson number was equivalent to both a γ unstable rotor and a rigid triaxial rotor with γ = 30°. Here it is shown that the proof given for this equivalence does not show that the eigenstates are equivalent in the two pictures but only that the subspaces for the low lying states are equivalent. A plausibility argument based on a dynamical symmetry of the γ = 30° rigid rotor is given which suggests that the excited states of the O(6) system are not equivalent to the excited states of the rigid triaxial rotor. The ground states, however, are equivalent.

47650 **Equation of state for dense nucleon matter.** Wiringa, R.B.; Fiks, V.; Fabrocini, A. (Physics Division, Argonne National Laboratory, Argonne, Illinois 60439). *Physical Review* [*Section*] *C: Nuclear Physics;* 38: No. 2, 1010-1037(Aug 1988).

We report microscopic calculations of the equation of state for dense nuclear and neutron matter. The calculations are performed for five Hamiltonians: the Argonne v/sub 14/ and Urbana v/sub 14/ two-nucleon potentials, both alone and with the Urbana VII three-nucleon potential, and the density-dependent Urbana v/sub 14/ plus three-nucleon interaction model of Lagaris, Friedman, and Pandharipande. The beta-stable equation of state and neutron star structure are also calculated for three of the models. The models with the three-nucleon potential bracket the density-dependent model and are significantly stiffer than those with an unmodified two-nucleon potential only. The Argonne v/sub 14/ plus Urbana VII Hamiltonian produces a softening in the neutron matter equation of state localized around twice nuclear matter density which may indicate a neutral pion condensate.

47651 **Statistical E1 and M1 gamma strength functions from heavy-ion, xnγ data.** Leander, G.A. (UNISOR, Oak Ridge Associated Universities, Oak Ridge, Tennessee 37830). *Physical Review* [*Section*] *C: Nuclear Physics;* 38: No. 2, 728-736(Aug 1988).

A statistical model analysis of heavy-ion, xnγ data puts constraints on the electromagnetic dipole strength functions at low energies, E/sub γ/~0.5—4 MeV. The M1 strength is inferred to be up to an order of magnitude smaller than at the higher energies of neutron capture gamma rays. The analysis supports the Kadmensky-Markushev-Furman shape of the E1 strength function, with a low-energy tail of the giant resonance that is suppressed relative to the shape based on a Lorentzian. The data considered include the yrast feeding pattern in the N = 92 isotones /sup 160/Er, /sup 162/Yb, and /sup 164/Hf, and in /sup 152/Dy up to spin 60(h/2π).

47652 **Collective flow and pion production in a hydrodynamic model.** Zingman, J.A.; McAbee, T.L.; Wilson, J.R.; Alonso, C.T. (Lawrence Livermore National Laboratory, Livermore, California 94550). *Physical Review* [*Section*] *C: Nuclear Physics;* 38: No. 2, 760-764(Aug 1988).

A new heavy-ion collision model which couples ideal, relativistic hydrodynamics with dynamical pions is described. The collective flow predicted by the model is shown to compare favorably to results obtained in earlier hydrodynamic calculations using quite different numerical methods. Discrepancies with experimental data are discussed, as are possible resolutions of the differences. Pion multiplicities resulting from the model are presented along with their experimental implications. Extensions to the model are discussed as well.

47653 **Semiclassical analysis of the SO(3,1) S matrix.** Hussein, M.S.; Pato, M.P.; Iachello, F. (Instituto de Fisica, Universidade de Sa-tildeo Paulo, 01498 Sa-tildeo Paulo, Sa-tildeo Paulo, Brazil). *Physical Review [Section] C: Nuclear Physics;* 38: No. 2, 1072-1075(Aug 1988).

We perform a semiclassical analysis of the SO(3,1) S matrix. In particular, we discuss the near-far components of the amplitude and describe the nuclear rainbow scattering. We use the semiclassical inverse scattering theory to obtain the underlying potential, which is found to behave as r/sup -1/2/e/sup -r/a/ at large separations.

47654 **Shell model predictions for /sup 19/N(βp)/sup 19/O.** Warburton, E.K. (Brookhaven National Laboratory, Upton, New York 11973). *Physical Review [Section] C: Nuclear Physics;* 38: No. 2, 935-939(Aug 1988).

The energy spectra and wave functions of /sup 19/N and /sup 19/O are calculated using a modification of the Millener-Kurath interaction. The results are used to predict the half-life and decay modes of both the allowed and first-forbidden β^- decays of /sup 19/N. Comparison is made to recent experiments.

6540 Radiation And Shielding Physics

REFER ALSO TO CITATION(S) 47965

47655 **(EFI—953(3)-87) Coherence effects of quasi-Cherenkov radiation in monocrystals in Laue and Bragg geometry.** Aginyan, M.A.; Yang, C. (Erevanskij Fizicheskij Inst. (USSR)). 1987. 19p. (In Russian). NTIS (US Sales Only), PC A03/MF A01. Order Number DE88703815/JAW.

The number of quanta N/sub h/ of coherent X-rays ("quasi-Cherenkov radiation") produced by a relativistic charged particles in monocrystals at Bragg angles O/sub B/ and frequencies ω/sub B/ as a funcrion of crystal thickness a is shown with regard to its absorbing ability and the γ-particle Lorentz factor. It is shown that in thin crystals the quasi-Cherenkov radiation intensity linearly grows with the thickness. At intermediate thickness interference effects are found in the Laue geometry, analogous to the well-known "pendulum effect" in X-ray scattering, while in the Bragg geometry N/sub h/ weakly depends on a. N/sub h/ grows with the further growth of a. In thick crystals N/sub h/ becomes saturated. It is characteristic, that saturation in the Laue geometry occurs in thickness several times exceeding the absorption length of X-rays of the same frequency in corresponding amorphous medium. N/sub h/ practically is independent on γ at large γ for intermediate and large thickness. It monotonically grows with γ at small thickness and γ. Calculations are compared with the experimental data. 17 refs.; 3 figs.; 1 tab.

47656 (INIS-BR—1164, pp 27) **Ultra-thin monochromator for synchrotron light.** Cusatis, C. (Parana Univ., Curitiba (Brazil). Dept. de Fisica). 1987. (In Portuguese). NTIS (US Sales Only), PC A09/MF A01. Order Number DE88703566/JAW. (CONF-8705181—).

From 10. national meeting on condensed matter physics; Caxambu, Brazil (5 May 1987).

47657 (INIS-BR—1164, pp 28) **Four-reflexion silicon monolithic monochromator with harmonic suppression for synchroton radiation.** Baran, Z. (Bahia Univ., Salvador (Brazil). Inst. de Fisica). 1987. (In Portuguese). NTIS (US Sales Only), PC A09/MF A01. Order Number DE88703566/JAW. (CONF-8705181—).

From 10. national meeting on condensed matter physics; Caxambu, Brazil (5 May 1987).

47658 (INIS-BR—1164, pp 47) **Comparison between dynamical and kinematical theories in the integrated reflection power description of silicon monocrystals with high degree of perfection.** Goncalves, O.D.; Scheider, J.; Graaf, H. (Rio de Janeiro Univ. (Brazil). Inst. de Fisica; HMI, Berlin (Germany, F.R.)). 1987. (In Portuguese). NTIS (US Sales Only), PC A09/MF A01. Order Number DE88703566/JAW. (CONF-8705181—).

From 10. national meeting on condensed matter physics; Caxambu, Brazil (5 May 1987).

47659 **(IYF-R—9-289) On a scattering cross section of X-ray divergence beam in conditions of sound instability.** Pustovojt, V.I.; Radzhabov, R.U.; Tenishev, V.P. (AN Uzbekskoj SSR, Tashkent. Inst. Yadernoj Fiziki). 1987. 7p. (In Russian). NTIS (US Sales Only), PC A02/MF A01. Order Number DE88703646/JAW.

The expression for the intensity of X-rays scattered in sound instability piezosemiconductors is found by the kinematical diffraction theory approximation. It is shown that due to one phonon interaction the scattering intensity increase in direction structural maximum taking into account divergence of incident beam. 5 refs.

47660 **(LA-UR—88-1746) Inelastic neutron scattering with polarization analysis.** Pynn, R.; Boucher, J.P.; Regnault, L.P. (Los Alamos National Lab., NM (USA)). 1988. Contract W-7405-ENG-36. 21p. (CONF-880715—4). NTIS, PC A03/MF A01; 1; GPO Dep. Order Number DE88014476/JAW.

From 4. international conference on neutron scattering (ICNS '88); Grenoble, France (12 Jul 1988).

Advances in neutron technology made during the past decade have permitted neutron inelastic scattering experiments to be performed with full polarization analysis. The power of this technique for the identification of components of dynamic spin fluctuations in magnetic systems is illustrated in this presentation by two experiments on the one-dimensional, X-Y antiferromagnet TMMC. In one experiment, spin fluctuations due to π-solitons were measured for the first time and information was obtained on soliton-soliton collision processes. In the other, a theory which apparently described finite-energy magnetic excitations measured with unpolarized neutrons was shown to be deficient. Both of these experiments were carried out at the Institut Laue-Langevin in Grenoble, France. 13 refs., 8 figs.

47661 **(LA-UR—88-1988) The LANSCE [Los Alamos Neutron Scattering Center] software management environment.** Donahue, S.; Cort, G. (Los Alamos National Lab., NM (USA)). 1988. Contract W-7405-ENG-36. 14p. (CONF-880569—3). NTIS, PC A03/MF A01; 1; GPO Dep. Order Number DE88014436/JAW.

From DECUS spring symposium; Cincinnati, OH, USA (16 May 1988).

We present the details of an innovative software management environment implemented to address life cycle support requirements at the Los Alamos Neutron Scattering Center (LANSCE). The system provides an automated configuration management framework within which all software development and maintenance activities are performed. The LANSCE environment provides a comprehensive configuration management (CM) system based upon a commercially available CM tool. The CM component ensures the integrity of all LANSCE application software, automatically performs status accounting operations, and provides a flexible automated facility for rebuilding resident software components and restoring them to the baseline. It employs high-level data structures both to enhance significantly the level of automation that can be achieved and to provide extensive, integrated support to the software development community. We discuss the software management philosophy that led to the development of the LANSCE environment on programmer productivity, system integration and software management effectiveness. 8 refs., 4 figs.

47662 **(N—88-23714) BRYNTRN: a baryon transport computer code, computation procedures and data base.** Wilson, J.W.; Townsend, L.W.; Chun, S.Y.; Buck, W.W.; Khan, F.; Cucinotta, F. (National Aeronautics and Space Administration, Hampton, VA (USA). Langley Research Center). Jun 1988. 43p. (NASA-TM—4037; L—16432; NAS—1.15:4037). NTIS, PC A03/MF A01.

The development is described of an interaction data base and a numerical solution to the transport of baryons through the arbitrary shield material based on a straight ahead approximation of the

Boltzmann equation. The code is most accurate for continuous energy boundary values but gives reasonable results for discrete spectra at the boundary with even a relatively coarse energy grid (30 points) and large spatial increments (1 cm in H_2O).

47663 **(RTS-R—001) Recent developments of the MARC/PN transport theory code including a treatment of anisotropic scatter.** Fletcher, J.K. (UKAEA Northern Research Labs., Risley. Risley Technical Services). Dec 1987. 12p. (CONF-870424—). NTIS (US Sales Only), PC A03/MF A01. Order Number DE88754293/JAW.

From American Nuclear Society international meeting on advances in reactor physics, mathematics and computation; Paris, France (27 Apr 1987).

The computer code MARC/PN provides a solution of the multigroup transport equation by expanding the flux in spherical harmonics. The coefficients of the series so obtained satisfy linked first order differential equations, and on eliminating terms associated with odd parity harmonics a second order system results which can be solved by established finite difference or finite element techniques. This report describes modifications incorporated in MARC/PN to allow for anisotropic scattering, and the modelling of irregular exterior boundaries in the finite element option. The latter development leads to substantial reductions in problem size, particularly for three dimensions. Also, links to an interactive graphics mesh generator (SUPERTAB) have been added. The final section of the report contains results from problems showing the effects of anisotropic scatter and the ability of the code to model irregular geometries.

47664 **Transmission optical device to produce intense polarized neutron beams.** Mook, H.A.; Hayter, J.B. (Solid State Division, Oak Ridge National Laboratory, Oak Ridge, Tennessee 37831-6031). *Applied Physics Letters;* **53**: No. 8, 648-650(22 Aug 1988).

It is shown how a device can be constructed using a stack of magnetic supermirrors to produce high-intensity polarized neutron beams with a large area. The device makes use of the fact that single-crystal Si is transparent to neutrons. A prototypical device has been constructed which provides 64% neutron efficiency with 20 min collimation.

47665 **Note on the singular eigenfunction method in transport theory.** Slawny, J.; Zweifel, P.F. (Center for Transport Theory and Mathematical Physics, Virginia Polytechnic Institute and State University, Blacksburg, VA 24061). *Transport Theory and Statistical Physics;* **17**: No. 2, 283-294(Apr 1988).

The purpose of this note is to show how the singular eigenfunction method for solving transport equations can be made rigorous. We do this by supplying proofs for a few manipulations taken for granted in the formalism which, on closer analysis, turn out to be perfectly correct. This work will concentrate on a proof that the putative solution, derived from the boundary data expansion, actually satisfies the equation and the boundary conditions at $x = 0$ and $x = \infty$. (AIP)

47666 **Vector methods for neutron diffusion theory.** Abu-Shumays, I.K. *Transactions of the American Nuclear Society;* **55**: 317-319(1987). (CONF-8711195—).

From American Nuclear Society winter meeting; Los Angeles, CA, USA (15 Nov 1987).

Practical multidimensional diffusion problems require considerable computer resources. To improve nuclear design analyses using capabilities of current and anticipated future generations of supercomputers, new efficient solution procedures are essential for solving very large diffusion problems. One such procedure is vectorization of the one energy-group diffusion equation. Fortunately, discrete approximations to the diffusion equations can be cast in several forms, the solution of each of which is amenable to vector and/or parallel computations. While vector length is important, the theme here is overall balance between various parts of a computation. Thus, alternative methods and associated vectorization algorithms are sought and judged in terms of net effective computer resource utilization. Solution of the one energy-group diffusion equation is a central part of eigenvalue computations, which are typically solved by the method of source iteration with Chebyshev polynomial acceleration. Recently, polynomial methods with preconditioner based on incomplete odd-even cyclic reduction factorization have proved effective for solving block tridiagonal systems. The main contribution of the present paper is to extend these methods to the important case of red/black partitioning of equations and unknowns and to demonstrate that a significant reduction in computations can be realized by applying preconditioned polynomial methods to the reduced systems, which are obtained from the original systems by eliminating approximately half of the unknowns.

47667 **Parallel solutions of the two-group neutron diffusion equations.** Zee, K.S.; Turinsky, P.J. *Transactions of the American Nuclear Society;* **55**: 319-320(1987). (CONF-8711195—).

From American Nuclear Society winter meeting; Los Angeles, CA, USA (15 Nov 1987).

Recent efforts to adapt various numerical solution algorithms to parallel computer architectures have addressed the possibility of substantially reducing the running time of few-group neutron diffusion calculations. The authors have developed an efficient iterative parallel algorithm and an associated computer code for the rapid solution of the finite difference method representation of the two-group neutron diffusion equations on the CRAY X/MP-48 supercomputer having multi-CPUs and vector pipelines. For realistic simulation of light water reactor cores, the code employees a macroscopic depletion model with trace capability for selected fission product transients and critical boron. In addition to this, moderator and fuel temperature feedback models are also incorporated into the code. The validity of the physics models used in the code were benchmarked against qualified codes and proved accurate. This work is an extension of previous work in that various feedback effects are accounted for in the system; the entire code is structured to accommodate extensive vectorization; and an additional parallelism by multitasking is achieved not only for the solution of the matrix equations associated with the inner iterations but also for the other segments of the code, e.g., outer iterations.

47668 **Parallel discrete ordinates algorithms on distributed and common memory systems.** Wienke, B.R.; Hiromoto, R.E.; Brickner, R.G. (Los Alamos National Lab., NM (USA)). *Transactions of the American Nuclear Society;* **55**: 321-323(1987). (CONF-8711195—).

From American Nuclear Society winter meeting; Los Angeles, CA, USA (15 Nov 1987).

The S/sub n/ algorithm employs iterative techniques in solving the linear Boltzmann equation. These methods, both ordered and chaotic, were compared on both the Denelcor HEP and the Intel hypercube. Strategies are linked to the organization and accessibility of memory (common memory versus distributed memory architectures), with common concern for acquisition of global information. Apart from this, the inherent parallelism of the algorithm maps directly onto the two architectures. Results comparing execution times, speedup, and efficiency are based on a representative 16-group (full upscatter and downscatter) sample problem. Calculations were performed on both the Los Alamos National Laboratory (LANL) Denelcor HEP and the LANL Intel hypercube. The Denelcor HEP is a 64-bit multi-instruction, multidate MIMD machine consisting of up to 16 process execution modules (PEMs), each capable of executing 64 processes concurrently. Each PEM can cooperate on a job, or run several unrelated jobs, and share a common global memory through a crossbar switch. The Intel hypercube, on the other hand, is a distributed memory system composed of 128 processing elements, each with its own local memory. Processing elements are connected in a nearest-neighbor hypercube configuration and sharing of data among processors requires execution of explicit message-passing constructs.

6550 Medical Physics

REFER ALSO TO CITATION(S) 46612, 46657, 47032, 47306, 47374

47669 (INIS-BR—1164, pp 81) **Detection of beta radiation emitted from coulored wall tile.** Caldas, L.V.E. (Instituto de Pesquisas Energeticas e Nucleares, Sao Paulo (Brazil)). 1987. (In Portuguese). NTIS (US Sales Only), PC A09/MF A01. Order Number DE88703566/JAW. (CONF-8705181—).

From 10. national meeting on condensed matter physics; Caxambu, Brazil (5 May 1987).

47670 (INIS-BR—1198) **Medical follow-up program for the victims of the Goiania radiation accidents.** Oliveira, A.R. de. (NUCLEBRAS, Rio de Janeiro (Brazil)). 1988. 1p. NTIS (US Sales Only), PC A02/MF A01. Order Number DE88703890/JAW.

6560 Condensed Matter Physics

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47671 (CONF-880705—4) **Polarized neutron studies of forbidden magnon scattering in gadolinium.** Cable, J.W.; Nicklow, R.M. (Oak Ridge National Lab., TN (USA)). 1988. Contract AC05-84OR21400. 10p. NTIS, PC A02/MF A01; 1; GPO Dep. Order Number DE88014545/JAW.

From International conference on magnetism; Paris, France (25 Jul 1988).

Forbidden magnon scattering from Gd was investigated using polarized neutrons. In contrast to earlier results for itinerant electron ferromagnets, forbidden magnons were not observed for this Heisenberg ferromagnet. This suggests that magnetic short range order is more important in the thermally-induced spin-disordering of the itinerant electron systems.

47672 (CONF-8804166—1) **Comments on can band offsets be changed controllably?.** Martin, R.M. (Illinois Univ., Urbana (USA). Dept. of Physics). 1988. Contract AC02-76ER01198. 7p. NTIS, PC A02/MF A01; 1; GPO Dep. Order Number DE88014631/JAW.

From NATO advanced research workshop on band structure engineering and semiconductor microstructures; No City Given, Italy (10 Apr 1988).

Offsets of valence and conduction bands at interfaces are among the key design parameters which allow engineering of electronic properties of semiconductor heterostructures. In this paper are discussed some current theoretical ideas on the causes of the offsets and the extent to which the interface dipole can be changed by atomic scale control of the chemical composition at the interface. The primary conclusion is that significant variations appear possible by the dipoles due to oriented pairs of polar atoms at the interface. Conditions where this can occur are discussed. 35 refs., 3 figs.

47673 (INIS-BR—1157) **Proceedings of the 7. Latin American Symposium on Solid State Physics.** (Rio Grande do Sul Univ., Porto Alegre (Brazil); Centro Latino Americano de Fisica, Rio de Janeiro (Brazil)). 1981. 116p. (In Portuguese). (CONF-8109291—). NTIS (US Sales Only), PC A06/MF A01. Order Number DE88703560/JAW.

From 7. Latin American symposium on solid state physics; Gramado, Brazil (14 Sep 1981).

Studies on: electronic structure of semiconductors; magnetic materials; low temperatures physics; metallic surfaces; defects in metals; ion implantation, are presented. (M.C.K.).

47674 (INIS-BR—1157, pp 17) **Theoretical study of gallium arsenide doped with iron-group impurities.** Fazzio, A.; Leite, J.R.; Pino Junior, A.D. (Sao Paulo Univ. (Brazil). Inst. de Fisica). 1981. NTIS (US Sales Only), PC A06/MF A01. Order Number DE88703560/JAW. (CONF-8109291—).

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From 7. Latin American symposium on solid state physics; Gramado, Brazil (14 Sep 1981).

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From 10. national meeting on condensed matter physics; Caxambu, Brazil (5 May 1987).

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Papers on: amorphous materials; atomic and molecular physics; biophysics; crystallography; defects, growth and characterization of crystals; statistical physics; instrumentation; liquid crystals; magnetism; science of materials/mechanical properties; metals and alloys; optic; magnetic resonance; and semiconductors are presented. These papers have been abstracted and indexed separately. (M.C.K.).

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47703 (INIS-BR—1164, pp 53) **Ising model with correlated dilution in the Bethe lattice-spin glass phase.** Silva, J. Borges da; Coutinho, S.; Moreira, F.G.B. (Pernambuco Univ., Recife (Brazil). Dept. de Fisica). 1987. (In Portuguese). NTIS (US Sales Only), PC A09/MF A01. Order Number DE88703566/JAW. (CONF-8705181—).

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47823 (INIS-BR—1164, pp 120) **Moessbauer study of the Putinga meteorite.** Oliveira, J.C.P. de; Vasquez, A.; Roisenberg, A.; Vieira Junior, N. (Ceara Univ., Fortaleza (Brazil). Dept. de Fisica; Rio Grande do Sul Univ., Porto Alegre (Brazil). Inst. de Fisica; Rio Grande do Sul Univ., Porto Alegre (Brazil). Inst. de Geociencias). 1987. (In Portuguese). NTIS (US Sales Only), PC A09/MF A01. Order Number DE88703566/JAW. (CONF-8705181—).

From 10. national meeting on condensed matter physics; Caxambu, Brazil (5 May 1987).

47824 (INIS-BR—1164, pp 121) **Analysis by Moessbauer spectroscopy of Nova Petropolis meterite.** (Centro Brasileiro de Pesquisas Fisicas, Rio de Janeiro; Observatorio Nacional, Rio de Janeiro (Brazil)). 1987. (In Portuguese). NTIS (US Sales Only), PC A09/MF A01. Order Number DE88703566/JAW. (CONF-8705181—).

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47825 (INIS-BR—1164, pp 150) **Magnetic Cerenkov effect in the CdCr/sub 2/ Se/sub 4/ observed through the / sup 113/Cd NMR.** Fernandes, J.C.; Oliveira e Souza, J.B. de; Pink, H. (Universidade Federal Fluminense, Niteroi (Brazil). Inst. de Fisica; Siemens A.G. (Germany, F.R.)). 1987. (In Portuguese). NTIS (US Sales Only), PC A09/MF A01. Order Number DE88703566/JAW. (CONF-8705181—).

From 10. national meeting on condensed matter physics; Caxambu, Brazil (5 May 1987).

47826 (INIS-BR—1164, pp 150) **Nuclear-spin lattice relaxation in glasses.** Santos, E.J.P.; Engelsberg, M. (Pernambuco Univ., Recife (Brazil). Dept. de Fisica). 1987. (In Portuguese). NTIS (US Sales Only), PC A09/MF A01. Order Number DE88703566/JAW. (CONF-8705181—).

From 10. national meeting on condensed matter physics; Caxambu, Brazil (5 May 1987).

47827 (INIS-BR—1164, pp 151) **Image generation by NMR in ultralow fields.** Nascimento, G.C. do; Souza, R.E. de; Engelsberg, M. (Pernambuco Univ., Recife (Brazil). Dept. de Fisica). 1987. (In Portuguese). NTIS (US Sales Only), PC A09/MF A01. Order Number DE88703566/JAW. (CONF-8705181—).

From 10. national meeting on condensed matter physics; Caxambu, Brazil (5 May 1987).

47828 (INIS-BR—1164, pp 151) **RF bobine for image generation by NMR - Distributed LC resonator of medium capacity for 85 MHz.** Schmidt, M.A.; Tannus, A.; Bonagamba, T.J.; Leite, V.B.P.; Panepucci, H.C. (Sao Paulo Univ., Sao Carlos, SP (Brazil). Inst. de Fisica e Quimica). 1987. (In Portuguese). NTIS (US Sales Only), PC A09/MF A01. Order Number DE88703566/JAW. (CONF-8705181—).

From 10. national meeting on condensed matter physics; Caxambu, Brazil (5 May 1987).

47829 (INIS-BR—1164, pp 151) **Study of nuclear spin-lattice relaxation T/sub 1/ for /sup 54/Mn in the antiferromagnetic dielectric crystal MnCl/sub 2/.4H/sub 2/O.** Araujo, M.A.B. de; Stone, N.J. (Ceara Univ., Fortaleza (Brazil). Dept. de Fisica; Oxford Univ. (UK). Clarendon Lab.). 1987. NTIS (US Sales Only), PC A09/MF A01. Order Number DE88703566/JAW. (CONF-8705181—).

From 10. national meeting on condensed matter physics; Caxambu, Brazil (5 May 1987).

47830 (INIS-BR—1164, pp 152) **Measurements by EPR of the quadrupole interaction in monovalence osmium complexes.** Martins Junior, S.; Vugman, N.V. (Rio de Janeiro Univ. (Brazil). Inst. de Fisica). 1987. (In Portuguese). NTIS (US Sales Only), PC A09/MF A01. Order Number DE88703566/JAW. (CONF-8705181—).

From 10. national meeting on condensed matter physics; Caxambu, Brazil (5 May 1987).

47831 (INIS-BR—1164, pp 152) **Study by EPR of new bromated species of two-valence iridium.** Bastos, C.G.A.; Vugman, N.V. (Rio de Janeiro Univ. (Brazil). Inst. de Fisica). 1987. (In Portuguese). NTIS (US Sales Only), PC A09/MF A01. Order Number DE88703566/JAW. (CONF-8705181—).

From 10. national meeting on condensed matter physics; Caxambu, Brazil (5 May 1987).

47832 (INIS-BR—1164, pp 153) **Study by EPR of Fe/ sup 3+/ in (NH/sub 4/)/sub 2/InCl/sub 4/H/sub 2/O.** Partiti, C.S.M.; Piccini, A.; Rechenberg, H.R. (Pontificia Univ. Catolica de Sao Paulo (Brazil); Sao Paulo Univ. (Brazil). Inst. de Fisica). 1987. (In Portuguese). NTIS (US Sales Only), PC A09/MF A01. Order Number DE88703566/JAW. (CONF-8705181—).

From 10. national meeting on condensed matter physics; Caxambu, Brazil (5 May 1987).

47833 (INIS-BR—1164, pp 154) **Study by EPR of the α-β phase transformation in AlPO/sub 4/ cristobalite.** Biasi, R.S. de; Simoes, A. (Instituto Militar de Engenharia, Rio de Janeiro (Brazil)). 1987. (In Portuguese). NTIS (US Sales Only), PC A09/MF A01. Order Number DE88703566/JAW. (CONF-8705181—).

From 10. national meeting on condensed matter physics; Caxambu, Brazil (5 May 1987).

47834 (INIS-BR—1164, pp 154) **Study by EPR of V/sup 2+/ center formation in MgO.** Fernandes, A.A.R. (Instituto Militar de Engenharia, Rio de Janeiro (Brazil)). 1987. (In Portuguese). NTIS (US Sales Only), PC A09/MF A01. Order Number DE88703566/JAW. (CONF-8705181—).

From 10. national meeting on condensed matter physics; Caxambu, Brazil (5 May 1987).

47835 (INIS-BR—1164, pp 154) **EPR of the Mn/sup ++/ impurity in the AlCl/sub 3/-GIC.** Ceotto, G.; Rolla, S.; Barberis, G.E.; Rettori, C. (Universidade Estadual de Campinas (Brazil). Inst. de Fisica). 1987. (In Portuguese). NTIS (US Sales Only), PC A09/MF A01. Order Number DE88703566/JAW. (CONF-8705181—).

From 10. national meeting on condensed matter physics; Caxambu, Brazil (5 May 1987).

47836 (INIS-BR—1164, pp 155) **Correlation between defects responsible by the calcite thermoluminescence (TL) and ESR.** Tatumi, S.H.; Matsuoka, M.; Watanabe, S. (Sao Paulo Univ. (Brazil). Inst. de Fisica). 1987. (In Portuguese). NTIS (US Sales Only), PC A09/MF A01. Order Number DE88703566/JAW. (CONF-8705181—).

From 10. national meeting on condensed matter physics; Caxambu, Brazil (5 May 1987).

47837 (INIS-BR—1164, pp 156) **Thermal stability and half-life of paramagnetic defects produced by the ionizing radiation in material calcites: implications to the geochronology by EPR.** (Centro Brasileiro de Pesquisas Fisicas, Rio de Janeiro). 1987. (In Portuguese). NTIS (US Sales Only), PC A09/MF A01. Order Number DE88703566/JAW. (CONF-8705181—).

From 10. national meeting on condensed matter physics; Caxambu, Brazil (5 May 1987).

47838 (INIS-BR—1164, pp 157) **Nuclear magnetic resonance of the /sup 157/Gd in GdAl/sub 2/.** Oliveira, I.S.; Alves, K.M.B. 1987. (In Portuguese). NTIS (US Sales Only), PC A09/MF A01. Order Number DE88703566/JAW. (CONF-8705181—).

From 10. national meeting on condensed matter physics; Caxambu, Brazil (5 May 1987).

47839 (INIS-BR—1164, pp 159) **Impurities of transition metals in alloys with compounds III-V.** Pintanel, R.; Gomes, V.M.S.; Leite, J.R. (Sao Paulo Univ. (Brazil). Inst. de Fisica). 1987. (In Portuguese). NTIS (US Sales Only), PC A09/MF A01. Order Number DE88703566/JAW. (CONF-8705181—).

From 10. national meeting on condensed matter physics; Caxambu, Brazil (5 May 1987).

47840 (INIS-BR—1164, pp 160) **Crystalline boundary conditions for calculating defects in semiconductors: application to zinc selenide.** Guimaraes, P.S.; Siqueira, M.L. de. (Instituto de Pesquisas Espaciais, Sao Jose dos Campos (Brazil); Minas Gerais Univ., Belo Horizonte (Brazil)). 1987. (In Portuguese). NTIS (US Sales Only), PC A09/MF A01. Order Number DE88703566/JAW. (CONF-8705181—).

From 10. national meeting on condensed matter physics; Caxambu, Brazil (5 May 1987).

47841 (INIS-BR—1164, pp 160) **Electronic structure of 3d transition metal impurities in ZnSe.** Chacham, H.; Alves, J.L.A.; Siqueira, M.L. de. (Minas Gerais Univ., Belo Horizonte (Brazil). Dept. de Fisica). 1987. (In Portuguese). NTIS (US Sales Only), PC A09/MF A01. Order Number DE88703566/JAW. (CONF-8705181—).

From 10. national meeting on condensed matter physics; Caxambu, Brazil (5 May 1987).

47842 (INIS-BR—1164, pp 164) **Exciton binding energy in quantum well wires.** Degani, M.H.; Hipolito, O. (Sao Paulo Univ., Sao Carlos, SP (Brazil). Inst. de Fisica e Quimica). 1987. NTIS (US Sales Only), PC A09/MF A01. Order Number DE88703566/JAW. (CONF-8705181—).

From 10. national meeting on condensed matter physics; Caxambu, Brazil (5 May 1987).

47843 (INIS-BR—1164, pp 175) **Characterization by AES and SIMS of TiN and SiN films produced by reactive sputtering.** Achete, C.A.; Pasa, A.S. (Rio de Janeiro Univ. (Brazil). Coordenacao dos Programas de Pos-graduacao de Engenharia). 1987. (In Portuguese). NTIS (US Sales Only), PC A09/MF A01. Order Number DE88703566/JAW. (CONF-8705181—).

From 10. national meeting on condensed matter physics; Caxambu, Brazil (5 May 1987).

47844 (INIS-BR—1164, pp 179) **Electronic structure of iron-boron complex in silicon.** Assali, L.V.C.; Leite, J.R. (Sao Paulo Univ. (Brazil). Inst. de Fisica). 1987. (In Portuguese). NTIS (US Sales Only), PC A09/MF A01. Order Number DE88703566/JAW. (CONF-8705181—).

From 10. national meeting on condensed matter physics; Caxambu, Brazil (5 May 1987).

47845 (INIS-BR—1164, pp 65) **Transport properties of semiconductors plasmas under high DC electric fields.** Freire, V.N.; Vasconcellos, A.R.; Luzzi, R. (Universidade Estadual de Campinas (Brazil). Inst. de Fisica). 1987. NTIS (US Sales Only), PC A09/MF A01. Order Number DE88703566/JAW. (CONF-8705181—).

From 10. national meeting on condensed matter physics; Caxambu, Brazil (5 May 1987).

47846 (INIS-BR—1164, pp 163) **Electron-phonon interaction effects in a quasi-two dimensional electron gas in GaAs-Ga/sub 1-x/ Al/sub x/ As heterostructure.** Degani, M.H.; Hipolito, O. (Sao Paulo Univ., Sao Carlos, SP (Brazil). Inst. de Fisica e Quimica). 1987. NTIS (US Sales Only), PC A09/MF A01. Order Number DE88703566/JAW. (CONF-8705181—).

From 10. national meeting on condensed matter physics; Caxambu, Brazil (5 May 1987).

47847 (INIS-BR—1164, pp 163) **Many-body problem in quantum wires in GaAs-GaAlAs.** Degani, M.H.; Hipolito, O. (Sao Paulo Univ., Sao Carlos, SP (Brazil). Inst. de Fisica e Quimica). 1987. NTIS (US Sales Only), PC A09/MF A01. Order Number DE88703566/JAW. (CONF-8705181—).

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47848 (INIS-BR—1164, pp 164) **Excitons trapped in impurities: the bounded - unbounded phase transition.** Hornos, J.E.M.; Degani, M.H.; Hipolito, O. (Sao Paulo Univ., Sao Carlos, SP (Brazil). Inst. de Fisica e Quimica). 1987. NTIS (US Sales Only), PC A09/MF A01. Order Number DE88703566/JAW. (CONF-8705181—).

From 10. national meeting on condensed matter physics; Caxambu, Brazil (5 May 1987).

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47850 (INIS-BR—1164, pp 166) **Statical properties polarons in quasi-one dimensional semiconductor structures.** Degani, M.H.; Hipolito, O. (Sao Paulo Univ., Sao Carlos, SP (Brazil). Inst. de Fisica e Quimica). 1987. NTIS (US Sales Only), PC A09/MF A01. Order Number DE88703566/JAW. (CONF-8705181—).

From 10. national meeting on condensed matter physics; Caxambu, Brazil (5 May 1987).

47851 (INIS-BR—1164, pp 173) **Interband scattering in quasi-two dimensional semiconductor system.** Frota, H.O. da; Degani, M.H.; Hipolito, O. (Amazonas Univ., Manaus (Brazil); Sao Paulo Univ., Sao Carlos, SP (Brazil). Inst. de Fisica e Quimica). 1987. (In Portuguese). NTIS (US Sales Only), PC A09/MF A01. Order Number DE88703566/JAW. (CONF-8705181—).

From 10. national meeting on condensed matter physics; Caxambu, Brazil (5 May 1987).

47852 (INIS-BR—1164, pp 31) **Maximum likelihood determination of parameters for powder, Laue and divergent beam patterns.** Ratajczyk, E.; Keller, W.A. (Bahia Univ., Salvador (Brazil). Inst. de Fisica). 1987. NTIS (US Sales Only), PC A09/MF A01. Order Number DE88703566/JAW. (CONF-8705181—).

From 10. national meeting on condensed matter physics; Caxambu, Brazil (5 May 1987).

47853 (INIS-BR—1164, pp 44) **Ultraviolet and gamma radiation effect in the pink and colorless (morganite and goshenite) natural beryl photoluminescence.** Menezes, M.; Blak, A.R. (Sergipe Univ., Aracaju (Brazil). Inst. de Fisica; Sao Paulo Univ. (Brazil). Inst. de Fisica). 1987. (In Portuguese). NTIS (US Sales Only), PC A09/MF A01. Order Number DE88703566/JAW. (CONF-8705181—).

From 10. national meeting on condensed matter physics; Caxambu, Brazil (5 May 1987).

47854 (INIS-BR—1164, pp 96) **Spin wave chaotic dynamics: experiments with YIG.** Aguiar, F.M. de; Azevedo, A.; Rezende, S.M. (Pernambuco Univ., Recife (Brazil). Dept. de Fisica). 1987. (In Portuguese). NTIS (US Sales Only), PC A09/MF A01. Order Number DE88703566/JAW. (CONF-8705181—).

From 10. national meeting on condensed matter physics; Caxambu, Brazil (5 May 1987).

47855 (INIS-BR—1164, pp 117) **Localized modes of hydrogen in the Ti/sub 0,8/Zr/sub 0,2/CrMnH/sub 3/ compound: study by slow neutron inelastic scattering.** Mestnik Filho, J.; Vinhas, L.A. (Instituto de Pesquisas Energeticas e Nucleares, Sao Paulo (Brazil)). 1987. (In Portuguese). NTIS (US Sales Only), PC A09/MF A01. Order Number DE88703566/JAW. (CONF-8705181—).

From 10. national meeting on condensed matter physics; Caxambu, Brazil (5 May 1987).

47856 (INIS-BR—1164, pp 119) **Study of the effect of α particle implantation in compounds formed in the steel 1020 implanted with nitrogen.** Ramos, S.M.M.; Amaral, L.; Vasquez, A.; Silva, M.T.X.; Zawislak, F.C.; Behar, M. (Rio Grande do Sul Univ., Porto Alegre (Brazil). Inst. de Fisica). 1987. (In Portuguese). NTIS (US Sales Only), PC A09/MF A01. Order Number DE88703566/JAW. (CONF-8705181—).

From 10. national meeting on condensed matter physics; Caxambu, Brazil (5 May 1987).

47857 (INIS-BR—1164, pp 119) **Interdiffusion and reaction in Fe/Al bilayer III: identification of formed phases by thermal treatment in furnaces and by ion beam mixing.** Teixeira, S.R.; Dionisio, P.H.; Vasconcellos, M.A.Z.; Schreiner, W.H.; Baumvol, I.J.R.; Silveira, E.F. da. (Rio Grande do Sul Univ., Porto Alegre (Brazil); Pontificia Univ. Catolica do Rio de Janeiro (Brazil)). 1987. (In Portuguese). NTIS (US Sales Only), PC A09/MF A01. Order Number DE88703566/JAW. (CONF-8705181—).

From 10. national meeting on condensed matter physics; Caxambu, Brazil (5 May 1987).

47858 (INIS-BR—1164, pp 159) **Implantation of Au ions in GaAs: measurement of spatial distribution and its evolution with thermal treatments.** Olivieri, C.A.; Galzerani, J.C.; Livi, R.P.; Prince, F.C. de. (Sao Carlos Univ. (Brazil). Dept. de Fisica; Rio Grande do Sul Univ., Porto Alegre (Brazil). Inst. de Fisica; Universidade Estadual de Campinas (Brazil). Inst. de Fisica). 1987. (In Portuguese). NTIS (US Sales Only), PC A09/MF A01. Order Number DE88703566/JAW. (CONF-8705181—).

From 10. national meeting on condensed matter physics; Caxambu, Brazil (5 May 1987).

47859 (INIS-BR—1164, pp 161) **Characterization of GaAs implanted with Mo.** Iikawa, F.; Motisuke, P.; Prince, F.C. de; Baumvol, I.J.R. (Universidade Estadual de Campinas (Brazil); Rio Grande do Sul Univ., Porto Alegre (Brazil)). 1987. (In Portuguese). NTIS (US Sales Only), PC A09/MF A01. Order Number DE88703566/JAW. (CONF-8705181—).

From 10. national meeting on condensed matter physics; Caxambu, Brazil (5 May 1987).

47860 (SAND—88-0270C) **Electronic properties of σ-conjugated polysilanes.** Kepler, R.G. (Sandia National Labs., Albuquerque, NM (USA)). 1988. Contract AC04-76DP00789. 9p. (CONF-880669—5). NTIS, PC A02/MF A01; 1; GPO Dep. Order Number DE88012699/JAW.

From International conference on science and technology of synthetic metals; Santa Fe, NM, USA (26 Jun 1988).

Recent experimental results on charge carrier transport, charge carrier generation and exciton-exciton annihilation in σ-conjugated polysilanes show that these materials have many interesting properties. The principal conclusions from these studies are: (1) only holes are mobile and in poly(phenyl methyl silane) the transport is non-dispersive with a mobility of 10^{-4}cm²/Vs; (2) charge carrier generation does not occur by band-to-band transitions but by injection from the surface when excitons contact the surface; and (3) singlet excitons are highly mobile in polysilanes and exciton-exciton annihilation is an important process at incident light intensities as low as 100W/cm², if the light is strongly absorbed. 13 refs., 4 figs.

47861 **Series expansions for clustering in continuum—percolation models with interactions.** Sen, A.K.; Torquato, S. (Department of Mechanical and Aerospace Engineering, North Carolina State University, Raleigh, North Carolina 27695-7910). *Journal of Chemical Physics;* 89: No. 6, 3799-3807(15 Sep 1988).

The low-density expansions of the concentration of monomers, dimers, trimers, and the mean cluster size are computed exactly, up through three-body cluster integrals, for a continuum—percolation model of spheres characterized by both exclusion-volume repulsions and short-range attractions. The compactness of trimers for our model is studied in the dilute limit. Interestingly, the [1,1] Pade approximant of the mean cluster size yields percolation thresholds which exhibit the proper qualitative dependence on the strengths of the repulsive and attractive interactions. The predicted thresholds agree qualitatively well with the trends reported in a Monte Carlo study by Bug et al.

47862 **Negative-ion formation on alkali-metal surfaces.** Wang, Y.; Huels, M.A.; Gallagher, D.R.; Doverspike, L.D.; Champion, R.L. (Department of Physics, College of William and Mary, Williamsburg, Virginia 23185). *Physical Review Letters;* 61: No. 10, 1194-1197(5 Sep 1988).

Thermal SF_6 molecules have been observed to decompose and desorb as various atomic and molecular negative ions upon impact with room-temperature, alkali-metal surfaces. Many of the negative ions observed have electron affinities which are less than the alkali-metal work function; hence the mechanism for ion formation and desorption is complex. A simple model is proposed to account for some of the observations.

47863 **Photoluminescence line shape in degenerate semiconductor quantum wells.** Lyo, S.K.; Jones, E.D. (Sandia National Laboratories, Albuquerque, New Mexico 87185). *Physical Review* [*Section*] *B: Condensed Matter;* 38: No. 6, 4113-4119(15 Aug 1988).

A microscopic theory and data are presented for the steady-state photoluminescence line shape at low lattice temperatures in modulation-doped degenerate direct-band-gap semiconductor quantum wells which are excited by a low-intensity cw laser. Electron-hole recombinations occur through direct as well as impurity-assisted (indirect) processes. In our theoretical model the photoluminescence linewidths and spectral shifts arise primarily from ionized-impurity scattering of the majority and minority carriers with smaller contributions from the thermal distribution of the carriers. The dependencies of the line shape on the doping configuration (e.g., space-layer thickness) and the carrier temperature are studied. The theory yields good agreement with the line shape of luminescence data from the modulation-doped n-type and p-type strained In/sub x/Ga/sub 1-//sub x//GaAs quantum wells with no adjustable parameters.

47864 **Simulated annealing with floating Gaussians: Hellmann-Feynman forces without corrections.** Pederson, M.R.; Klein, B.M.; Broughton, J.Q. (Condensed Matter Physics Branch, Naval Research Laboratory, Washington, D.C. 20375-5000). *Physical Review* [*Section*] *B: Condensed Matter;* 38: No. 6, 3825-3833(15 Aug 1988).

An all-electron density-functional-based molecular-dynamical algorithm for static and dynamic studies of atomic clusters is formulated and discussed. A time-dependent fictitious Lagrangian that depends on both the classical nuclear positions as well as the quantum-mechanical electronic variational parameters is introduced. By integrating the resulting equations of motion, the static ground state of a many-electron and -nuclei system may be found. A floating Gaussian formulation is introduced, and we demonstrate that, by allowing the nonlinear Gaussian parameters and positions to vary so

as to minimize the total energy, the Pulay corrections to the Hellmann-Feynman force vanish. Further advantages of this method over conventional diagonalization schemes are that it allows for a compact self-optimizing basis set and that the algorithm is not susceptible to numerical instabilities when nearly, or exact, linear dependencies are encountered. By expanding the electronic wave functions in terms of floating s-type Gaussian orbitals, the method is illustrated with applications to the Li_2 molecule and the Ne atom. Results are in excellent agreement with other theoretical results and experiments.

47865 **Electronic-structure method for general space-filling cell potentials.** Gonis, A.; Zhang, X.; Nicholson, D.M. (Division of Chemistry and Materials Science, L-280, Lawrence Livermore National Laboratory, Livermore, California 94550). *Physical Review* [*Section*] *B: Condensed Matter;* **38**: No. 5, 3564-3567(15 Aug 1988).

It is shown that the scattering matrix in the form describing multiple-scattering processes for collections of muffin-tin (MT) potentials is rigorously valid for nonoverlapping potentials of arbitrary shape. In particular, the near-field corrections (NFC's) ostensibly arising in the latter case are shown to vanish identically. It follows that the well-known method of Korringa and of Kohn and Rostoker for calculating electronic structure is valid for non-MT potentials. Model calculations illustrating directly the vanishing of NFC's and a calculation for elemental Nb are presented and the effects of convergence in such calculations are discussed.

47866 **Spectrum of surface-mode contributions to the differential energy-loss probability for electrons passing by a spheroid.** Illman, B.L.; Anderson, V.E.; Warmack, R.J.; Ferrell, T.L. (Health and Safety Research Division, Oak Ridge National Laboratory, Oak Ridge, Tennessee 37831-6123). *Physical Review* [*Section*] *B: Condensed Matter;* **38**: No. 5, 3045-3049(15 Aug 1988).

The differential probability of energy loss for a charged-particle beam moving past a spheroid along the direction of a symmetry axis is obtained. Local, frequency-dependent, dielectric functions are used to describe the response of the spheroid and the medium containing the rectilinear trajectory of the beam. While retardation is neglected, all modes are included in the analytical results. Both oblate and prolate spheroids and their counterpart voids are discussed, and numerical results are given for materials of experimental interest.

47867 **Lipkin replies.** Lipkin, H.J. (Department of Nuclear Physics, Weizmann Institute of Science, Rehovot 76100, Israel). *Physical Review Letters;* **61**: No. 5, 654-654(1 Aug 1988).

The Comment by G. T. Trammell and J. P. Hannon correctly points out an eroneous statement in my paper.

47868 **Broadening of a resonant absorption line in the presence of simultaneous ion-ion and ion-electron relaxations: A first application of the continuous moments method.** Bloch, J.M. (Material Science Division, Argonne National Laboratory, 9700 South Cass Avenue, Argonne, Illinois 60939). *Physical Review* [*Section*] *B: Condensed Matter;* **38**: No. 4, 2243-2249(1 Aug 1988).

The modified method of moments for a continuous system is applied to a system of paramagnetic impurities which experience both magnetic relaxation via contact coupling to conduction-electron spins and also exchange interaction among the ions. It is shown that this technique reproduces the known linewidth dependence for each interaction in the absence of the other. A simple algebraic expression is derived here for the case where both interactions occur simultaneously. This result differs from the sums of those contributions used earlier. It exhibits a first application of the continuous method of moments. The application of this technique to more systems where electromagnetic radiation is absorbed in a quasicontinuous level scheme is also discussed.

47869 **Theory of deep inelastic neutron scattering: Hard-core perturbation theory.** Silver, R.N. (Theoretical Division, Los Alamos Neutron Scattering Center, MS B262, Group T-11, Los Alamos National Laboratory, Los Alamos, New Mexico 87545). *Physical Review* [*Section*] *B: Condensed Matter;* **38**: No. 4, 2283-2296(1 Aug 1988).

Details are presented of a new many-body theory for deep inelastic neutron scattering (DINS) experiments to measure momentum distributions in quantum fluids and solids. The high-momentum and energy-transfer scattering law in helium is shown to be a convolution of the impulse approximation with a final-state broadening function which depends on the scattering phase shifts and the radial distribution function. The predicted broadening satisfies approximate Y scaling, is neither Lorentzian nor Gaussian, and obeys the f, ω^2, and ω^4 sum rules. The derivation uses a combination of Liouville perturbation theory, projection superoperators, and semiclassical methods which I term "hard-core perturbation theory." A review is presented of the predictions of prior theories for DINS experiments in relation to the present work. A subsequent paper will present massive numerical predictions and a discussion of DINS experiments on superfluid ^{4}He.

47870 **X-ray and neutron scattering from rough surfaces.** Sinha, S.K.; Sirota, E.B.; Garoff, S.; Stanley, H.B. (Corporate Research Science Laboratory, Exxon Research and Engineering Company, Clinton Township, Route 22 East, Annandale, New Jersey 08801). *Physical Review* [*Section*] *B: Condensed Matter;* **38**: No. 4, 2297-2311(1 Aug 1988).

The scattering of x rays and neutrons from rough surfaces is calculated. It is split into specular reflection and diffuse scattering terms. These are calculated in the first Born approximation, and explicit expressions are given for surfaces whose roughness can be described as self-affine over finite length scales. Expressions are also given for scattering from liquid surfaces, where it is shown that "specular" reflections only exist by virtue of a finite length cutoff to the mean-square height fluctuations. Expressions are also given for the scattering from randomly oriented surfaces, as studied in a typical small-angle scattering experiment. It is shown how various well-known asymptotic power laws in S(q) are obtained from the above theory. The distorted-wave Born approximation is next used to treat the case where the scattering is large (e.g., near the critical angle for total external reflection), and its limits of validity are discussed. Finally, the theory is compared with experimental results on x-ray scattering from a polished Pyrex glass surface.

47871 **Total dielectric function: Algebraic sign, electron-lattice response, and superconductivity.** Allen, P.B.; Cohen, M.L.; Penn, D.R. (Condensed Matter Physics Branch, Naval Research Laboratory, Washington, D.C. 20375-5000). *Physical Review* [*Section*] *B: Condensed Matter;* **38**: No. 4, 2513-2525(1 Aug 1988).

The interaction between two test charges in a solid can be described in terms of a total dielectric function that includes electronic and lattice polarization. Crystal stability requires the eigenvalues of ϵ/sup -1/ to be ≤ 1. Some implications for superconductivity are discussed. A total dielectric function for the electron-lattice system is derived in the mean-field approximation and its inverse is explicitly constructed. The low-lying poles of ϵ/sup -1/ give the correct phonon frequencies as determined by the usual dynamical matrix.

47872 **Interface kinetics of freezing and melting with a density change.** Richards, P.M. (Sandia National Laboratories, P.O. Box 5800, Albuquerque, New Mexico 87185-5800). *Physical Review* [*Section*] *B: Condensed Matter;* **38**: No. 4, 2727-2739(1 Aug 1988).

The change in density between liquid and solid is shown to affect the interface velocity for rapid solidification or melting. The effect is asymmetric, being much more pronounced for freezing than for melting, regardless of whether the liquid is more or less dense than the solid. Freezing velocity is limited by the rate at which a density excess can be transported away from or into the interface, but melting speed can still approach the speed of sound or thermal velocity. It is argued that relaxation of the density excess should be viewed on the molecular level, whereby diffusive

jumps take place. This leads to a much slower removal of the excess than if it were propagated away as sound and a corresponding much greater effect on the interface motion. A modified transition-state theory is presented which incorporates the density change. Comparison is made with experiments on silicon and with molecular-dynamics simulations of freezing of a Lennard-Jones liquid. Satisfactory agreement is obtained, particularly in regard to the large asymmetry between freezing and melting speeds observed near the melting point in silicon.

47873 **Dislocation structure and energy of high angle [001] twist boundaries: A computer simulation study.** Schwartz, D.; Bristowe, P.D.; Vitek, V. (Dept. of Materials Science and Engineering, Univ. of Pennsylvania, Philadelphia, PA (US)). *Acta Metallurgica;* **36**: No. 3, 675-694(Mar 1988).

High angle (001) twist boundaries have been frequently investigated experimentally and the presence of grain boundary dislocations (gbd's) and associated cusps in the dependence of the boundary energy on misorientation is in this case well established. However, in previous computer simulations of these boundaries neither localised gbd's nor distinct energy cusps have been identified. The principal aim of the present study is to clarify this discrepancy between observations and computer modelling. For this purpose the structure and energy of a number of long period (high Σ) twist boundaries with misorientations very close to $\Sigma = 5$ have been calculated using empirical pair and n-body potentials to describe interatomic forces. Furthermore, an isolated gbd embedded into a $\Sigma = 5$ boundary has been modelled. Well defined cusps at $\Sigma = 5$ misorientation and localised gbd's have been found but the reference $\Sigma = 5$ structure is always the lowest energy structure which, in general, does not possess the symmetry of the coincidence site lattice. The misorientation dependence of the boundary energy is then discussed using a Read-Shockley type model. The cusps are always very shallow and may have an uncoventional shape which is related to the dependence of the elastic energy on misorientation that is not the same for twist and tilt boundaries, contrary to what is usually assumed. Finally, some remaining discrepancies between observed types of gbd's and those found in the present study are discussed in the light of the previously proposed multiplicities of boundary structures.

47874 **The applicability of equilibrium calculations to dichlorosilane CVD.** Medernach, J.W.; Ho, P. (Sandia National Labs., PO Box 5800, Albuquerque, NM (US)). pp 101-111 of Proceedings of the tenth international conference on chemical vapor deposition, 1987. Cullen, G.W. Pennington, NJ; The Electrochemical Society (1987). (CONF-8710183—).

From 10. international conference on chemical vapor deposition; Honolulu, HI, USA (1 Oct 1987).

Equilibrium calculations were made for the chlorosilane (Si-H-Cl) system over a wide range of temperatures, pressures and Si/Cl ratios. The Si/Cl ratios are presented as a function of the Cl/H ratio, temperature and pressure. Three-dimensional contour plots of the equilibrium Si/Cl also give a qualitative picture. Comparison of observed and equilibrium deposition rates indicate the range of applicability for the chlorosilane system. Results of this study indicate that equilibrium calculations can serve as a useful guide for silicon deposition from dichlorosilane at temperatures $> 1000°C$ and pressures between 625 and 80 Torr. An application related to the silicon-on insulator (SOI) technology is presented.

47875 **Frequency conversion materials from a device perspective.** Eimerl, D. (Nonlinear Optical Materials Group, Lawrence Livermore National Lab., P.O. Box 808, L-490, Livermore, CA (US)). pp 2-5 of Laser and nonlinear optical materials. De Shazer, L.G. Bellingham, WA; SPIE Society of Photo-Optical Instrumentation Engineers (1986). (CONF-860880—).

From 30. SPIE technical symposium on optics and optoelectronic engineering; San Diego, CA, USA (17 Aug 1986).

The optimization of nonlinear optical devices such as frequency doublers is discussed. A nonlinear material will convert efficiently if the laser brightness (P/Q/sup 2/, where P is the peak power, and Q is the number of times diffraction-limited the pulse is) exceeds a material parameter called the threshold power. The conversion efficiency is shown to be independent of the beam aperture. Thus surmounting optical damage requires only that the beam aperture be large enough. Data on the threshold powers of common nonlinear materials is presented.

6561 Superconductivity

REFER ALSO TO CITATION(S) 46795, 46827, 46849, 46862, 46863, 46865, 46906, 46907, 46908, 46939, 46945, 46946, 46947, 46948, 46949, 46993, 47001, 47871

47876 **(BNL—41472) Lattice instability in single-crystal La/sub 2-x/Sr/sub x/CuO_4.** Boeni, P.; Axe, J.D.; Shirane, G.; Birgeneau, R.J.; Gabbe, D.R.; Jenssen, H.P.; Kastner, M.A.; Picone, P.J.; Thurston, T.R.; Sato, M. (Brookhaven National Lab., Upton, NY (USA); Paul Scherrer Inst. (PSI), Wuerenlingen (Switzerland); Massachusetts Inst. of Tech., Cambridge (USA). Center for Materials Science and Engineering; Institute for Molecular Science, Okazaki (Japan)). 1988. Contract AC02-76CH00016. 13p. (CONF-880715—3). NTIS, PC A03/MF A01; 1; GPO Dep. Order Number DE88013994/JAW.

From 4. international conference on neutron scattering (ICNS '88); Grenoble, France (12 Jul 1988).

The structural phase transition from the tetragonal to the orthorhombic phase of doped and undoped samples of La/sub 2-x/Sr/sub x/CuO_4 has been investigated by using inelastic neutron scattering techniques. The rotational nature of the soft mode leads to moderate electron-phonon coupling and the mode is unlikely to enhance significantly conventional phonon mediated superconductivity. 13 refs., 3 figs., 1 tab.

47877 **(DOE/ER/40077—4) The critical current density, the fabrication process and the microstructure in superconducting composites of NbTi for high energy physics: Report covering the period June 1, 1985-June 30, 1988.** Larbalestier, D.C. (Wisconsin Univ., Madison (USA). Applied Superconductivity Center). 1988. Contract AC02-82ER40077. 14p. NTIS, PC A03/MF A01; 1; GPO Dep. Order Number DE88014241/JAW.

This paper discusses the transport properties and microstructure of oxide superconductors. In particular, the high critical current density of Nb-Ti alloy is discussed. 49 refs., 5 figs. (LSP)

47878 **(ENEA-RT-FUS—87-27) Small field behavior of critical current in Y(1)Ba(2)Cu(3)O(7) sintered samples.** Paterno', G.; Alvani, C.; Casadio, S.; Gambardella, U.; Maritato, L. (ENEA, Rome (Italy)). Feb 1988. 9p. NTIS (US Sales Only), PC A02/MF A01. Order Number DE88754233/JAW.

Critical currents carried by sintered Y(1)Ba(2)Cu(3)O(7) superconducting samples were measured at different temperatures close to the critical temperature, Tc. The effects of an applied magnetic field perpendicular to the current direction were investigated. A strong reduction of the DC critical current for field values smaller than the lower critical field, Bc1, was observed. The magnetic field dependence was discussed in terms of weak coupling between grains. The experimental data showed excellent agreement, at low field values, with the theoretical dependence valid for a Josephson junction with strong inhomogeneities in the barrier.

47879 **(INIS-BR—1157, pp 39) Superconductivity and intermediate valence.** Allub, R. (Comision Nacional de Energia Atomica, San Carlos de Bariloche (Argentina). Centro Atomico Bariloche). 1981. (In Spanish). NTIS (US Sales Only), PC A06/MF A01. Order Number DE88703560/JAW. (CONF-8109291—).

From 7. Latin American symposium on solid state physics; Gramado, Brazil (14 Sep 1981).

47880 **(INIS-BR—1157, pp 49) Thermodynamics of superconducting lanthanum.** Baquero, R. (Universidad Autonoma de Puebla (Mexico). Inst. de Ciencias). 1981. NTIS (US Sales Only), PC A06/MF A01. Order Number DE88703560/JAW. (CONF-8109291—).

From 7. Latin American symposium on solid state physics; Gramado, Brazil (14 Sep 1981).

47881 **(PNL-SA—15807) Processing and characterization of monolithic high-temperature superconductors.** Weber, W.J.; Pederson, L.R. (Pacific Northwest Lab., Richland, WA (USA)). Mar 1988. Contract AC06-76RL01830. 9p. (CONF-880690—2). NTIS, PC A02. Order Number DE88014763/JAW.

From SAMPE electronic materials and processes conference; Seattle, WA, USA (14 Jun 1988).

Powders of high-temperature superconducting materials in the Y-Ba-Cu-O, Bi-Sr-Ca-Cu-O, and Tl-Ba-Ca-Cu-O systems have been prepared by solid-state reaction techniques. Monolithic samples of these materials have been produced by both sintering and plasma-spraying techniques. Controlled oxygen annealing is generally required to optimize the superconducting properties. These monolithic materials exhibit superconducting transition temperatures that exceed 80 K, with the highest observed transition temperature (105 K) in the Tl-Ba-Ca-Cu-O system. The measured critical current densities are low, however, due to the presence of weak links in the form of grain-boundary material and microcracks. 9 refs, 5 figs.

47882 **Upper critical fields of superconductor-ferromagnet multilayers.** Radovic, Z.; Dobrosavljevic-Grujic, L.; Buzdin, A.I.; Clem, J.R. (Department of Physics, Faculty of Science, Institute of Physics, Belgrade, Yugoslavia). *Physical Review [Section] B: Condensed Matter;* 38: No. 4, 2388-2393(1 Aug 1988).

Nucleation of the superconducting phase in superconductor-ferromagnet multilayers is studied theoretically. When the superconducting layers are thin and decoupled by pair breaking in the ferromagnetic layers, the parallel critical field exhibits a nonlinear temperature dependence and nonmonotonic thickness dependence. The perpendicular critical field, corresponding to the nucleation of strongly modulated vortices, is also calculated. The theoretical results are in good agreement with experimental data for V/Fe multilayers.

47883 **Coupled-spin—mobile-hole model for high-T/sub c/ superconducting oxides.** Loh E.Y. Jr.; Martin, T.; Prelovsek, P.; Campbell, D.K. (Center for Nonlinear Studies, Los Alamos National Laboratory, Los Alamos, New Mexico 87545). *Physical Review [Section] B: Condensed Matter;* 38: No. 4, 2494-2503(1 Aug 1988).

A model representing a system of coupled localized spins and mobile holes and relevant to superconducting copper oxides is analyzed by performing both exact diagonalizations on small systems and variational calculations. Ground-state expectation values, susceptibilities, optical conductivity and pairing correlations are calculated for systems with up to six unit cells arranged on a ring or representing a square lattice. With increasing spin—mobile-hole coupling, our results show a transition to a regime of mobile singlets and short-range magnetic correlations. On the square lattice, the interaction weakly enhances the d-wave pairing, but suppresses s-wave and extended s/sup */-wave correlations.

47884 **Charge-transfer strings in the extended Hubbard model for copper oxide superconductors.** Schuettler, H. (Center for Simulational Physics, Department of Physics and Astronomy, University of Georgia, Athens, Georgia 30602). *Physical Review [Section] B: Condensed Matter;* 38: No. 4, 2854-2857(1 Aug 1988).

Near the Cu/sup 2+/-→Cu^{+} valence instability, there are low-lying excitations in the extended Hubbard model for CuO_2 superconductors which consist of spatially extended, contiguous strings of Cu^{+}-O^{-} pairs. Such strings can be electrically neutral or carry charges +e or -e. Results for the string band structure, their internal excitations, and possible attractive string-pairing interactions are presented. Important experimental implications are discussed.

6570 Theoretical And Mathematical Physics

REFER ALSO TO CITATION(S) 47094, 47151, 47444, 47448, 47562, 47580

47885 **(BNL—41475) The compatibility of gravity and kaon results in the search for new forces.** Aronson, S.; Fischbach, E.; Sudarsky, D.; Talmadge, C. (Brookhaven National Lab., Upton, NY (USA)). 1988. Contract AC02-76CH00016. 10p. (CONF-880173—5). NTIS, PC A02/MF A01; 1; GPO Dep. Order Number DE88013993/JAW.

From 22. Moriond workshop on neutrinos and exotic phenomena in particle physics and astrophysics; Les Arcs, France (23 Jan 1988).

The existing data on energy-dependences of the fundamental parameters of K°-{bar K}° system, and the limits on the decay $K^{+} \rightarrow \pi^{+}$ + (invisible neutrals), are used in conjunction with geophysical data to explore the coupling of the putative fifth force to quantities other than baryon number. 21 refs., 2 tabs.

47886 **(DOE/ER/45224—4) [Theory of defects in nonmetallic solids]: Progress report, 1 August 1985-1 May 1988.** (Michigan Technological Univ., Houghton (USA)). 1988. Contract FG02-85ER45224. 27p. NTIS, PC A03/MF A01; 1; GPO Dep. Order Number DE88013075/JAW.

A general method based upon ab initio quantum mechanics is being used to study lattice defects in crystalline materials. The model treats the impurity electronic structure and lattice response to the impurity in a self-consistent manner. Simulation of an infinite lattice containing a point defect represented by a cluster may be carried out by minimizing the total energy with respect to parameters that define the lattice configuration, including the defect. States other than ground states may be analyzed by applying symmetry constraints to the calculation. Embedded molecular clusters representing segments of perfect lattice may also be studied. The procedure described above is a practical proposition, and is implemented in a program named ICECAP, for arbitrary host lattice, and for arbitrary point-defect composition and configuration. Recent applications of ICECAP, incorporating KKLP to color centers and to perfect-lattice clusters show that calculations in which lattice configuration and defect structure are simultaneously self-consistent are possible. Examples are presented.

47887 **(ENEA-RT-TIB—87-32) An algebraic view to operatorial ordering and its applications to optics.** Dattoli, G.; Torre, A.; Gallardo, J.C. (ENEA, Rome (Italy)). Dec 1987. 123p. NTIS (US Sales Only), PC A06/MF A01. Order Number DE88754236/JAW.

We discuss the problem of operatorial ordering within the framework of its applications to quantum optics. We devote particular attention to algebraic ordering techniques, which, in many cases, may be useful alternatives to the Feynman-Dyson expansion. A method is developed and then applied to a variety of physics problems, including the evolution of coherent states, the interaction of two and three level systems with radiation, the parametric amplifier, etc. Even though the method is mainly devoted to quantum dynamics, we demonstrate its usefulness in treating classical problems such as the paraxial propagation of light beams in lens-like media and pulse propagation in free electron lasers. Finally, the paper provides, as useful references, a number of simple disentanglement theorems of the BCH-type.

47888 **(IC—87/305) On the homology and the cohomology of certain polycyclic groups.** Majumdar, S. (International Centre for Theoretical Physics, Trieste (Italy)). Oct 1987. 9p. NTIS (US Sales Only), PC A02/MF A01. Order Number DE88703835/JAW.

The homology and the cohomology of infinite non-abelian split extensions of cyclic groups by cyclic groups have been computed through construction of nice free resolutions for these groups. (author). 16 refs.

47889 **(IC—88/26) Remarkable algebra so*(2n), its representations, its Clifford algebra and potential applications.** Barut, A.O.; Bracken, A.J. (International Centre for Theoretical Physics, Trieste (Italy)). Jan 1988. 30p. NTIS (US Sales Only), PC A03/MF A01. Order Number DE88703836/JAW.

Properties of the real Lie algebra so*(2n) and its finite-dimensional representations are described. The structure of the Clifford algebras associated with the two fundamental spinor representations are determined, and it is found in particular that for so*(4n), there is a remarkable asymmetry: one representation is real, the other complex (though equivalent to its complex conjugate), and the associated algebras are inequivalent. Generalized Dirac matrices are defined, acting within the direct sum of these two spinor representations of so*(2n). These matrices generate a different Clifford algebra, not determined uniquely by those representations, and their commutators do not span a representation of so*(2n). The isomorphisms of so*(6) with su(3,1), and of so*(8) with so(6,2) are described, together with the corresponding mappings between finite-dimensional irreducible representations. The latter isomorphism is related to the triality property of so(8), and in particular maps the real fundamental spinor representation, the complex fundamental spinor representation, and the complex vector (defining) representation of so*(8), each of dimension eight, into the real vector representation and the two complex fundamental spinor representations of so(6,2). More generally, some tensor representations of so*(8) are mapped into spinor, others into tensor representations of so(6,2) and the same is true of spinor representations of so*(8). This raises the possibility of interesting applications of so*(2n), n>4, as a generalized space-time symmetry or dynamical algebra, with tensor and spinor representations of so(3,1)<so*(2n) contained in an irreducible multiplet. Mention is made in particular of a recent proposal by Ward to base a unified field theory on so*(14)>so(3,1)+su(3)+su(2)+u(1). (author). 29 refs.

47890 **(IC—88/30) General form of Darboux transformations for Lax pairs.** Zhou Zixiang. (International Centre for Theoretical Physics, Trieste (Italy)). Mar 1988. 9p. NTIS (US Sales Only), PC A02/MF A01. Order Number DE88703837/JAW.

In this paper, the author finds all the Darboux transformations for general Lax pair with coefficients analytic to spectral parameter. The auto-Baecklund property of these Darboux transformations for n x n system is also verified. (author). 7 refs.

47891 **(IC—88/34) Weak solutions to the evolution problems of harmonic maps.** Chen Yunmei. (International Centre for Theoretical Physics, Trieste (Italy)). Feb 1988. 8p. NTIS (US Sales Only), PC A02/MF A01. Order Number DE88703838/JAW.

In this paper, the existence of global weak solutions to the evolution problems of the harmonic maps from compact Riemannian manifolds (without boundary) into spheres is proved. (author). 6 refs.

47892 **(IC—88/63) Finite elements for partial differential equations: An introductory survey.** Succi, S. (International Centre for Theoretical Physics, Trieste (Italy)). Mar 1988. 26p. NTIS (US Sales Only), PC A03/MF A01. Order Number DE88703845/JAW.

After presentation of the basic ideas behind the theory of the Finite Element Method, the application of the method to three equations of particular interest in Physics and Engineering is discussed in some detail, namely, a one-dimensional Sturm-Liouville problem, a two-dimensional linear Fokker-Planck equation and a two-dimensional nonlinear Navier-Stokes equation. 6 refs, 8 figs.

47893 **(IC—88/66) Gauss map for Kaehlerian submanifolds of R/sup n/.** Rigoli, M.; Tribuzy, R. (International Centre for Theoretical Physics, Trieste (Italy)). Mar 1988. 18p. NTIS (US Sales Only), PC A03/MF A01. Order Number DE88703848/JAW.

After the demonstration of some general theorems concerning the immersion f:M->R/sup n/ and its complex Gauss map, the theory is applied to the isometric case establishing for the complex Gauss map a formula which is the exact analogue of the classical relation between the third fundamental form, the Ricci form and the second fundamental tensor in the direction of the mean curvature for submanifolds of R/sup n/. 16 refs.

47894 **(IC—88/75) L/sup ∞/(R/sup n/) decay of the solutions on a class of Schroedinger equations.** Chen Yunmei. (International Centre for Theoretical Physics, Trieste (Italy)). Apr 1988. 13p. NTIS (US Sales Only), PC A03/MF A01. Order Number DE88703850/JAW.

Let u be the classical solution of the following initial value problem: iu/sub t/+Δu=k(1-exp(-achemical bonduchemical bond/sup 2/))u, u(0,x)=phi, x is an element of R/sup n/, t is an element of R/sup +/ where k is an element of R and a > 0. Then, when n=2, k ≧ 0 or k < 0 with /sup chemical bondkchemical bond/ / sup chemical bondchemical bondphichemical bondchemical bond/ L/sup 2/(R/sup 2/)<2π/a and when n=3, k ≧ 0, the L/sup ∞/(R/sup n/) norm of u decays as t -> ∞ at the rate as that of the solution to the free Schroedinger equation. (author). 5 refs.

47895 **(IC—88/76) Class of strongly degenerate elliptic operators.** Duong Minh Duc. (International Centre for Theoretical Physics, Trieste (Italy)). Apr 1988. 26p. NTIS (US Sales Only), PC A03/MF A01. Order Number DE88703851/JAW.

Using a weighted Poincare inequality, we study (ω/sub 1/,...,ω/sub n/)-elliptic operators. This method is applicable to solve singular elliptic equations with conditions in W/sup 1,2/ on the boundary. We also get a result about the regularity of solutions of singular elliptic equations. An application to (ω/sub 1/,...ω/sub n/)-parabolic equations is given. (author). 33 refs.

47896 **(IC—88/82) Equivalence of the spinning superparticle descriptions with Grassmann variables or with c-number spinors.** Barut, A.O.; Pavsic, M. (International Centre for Theoretical Physics, Trieste (Italy)). May 1988. 16p. NTIS (US Sales Only), PC A03/MF A01. Order Number DE88703856/JAW.

A remarkable equivalence is established between the theories of spinning particles or superparticles using anticommuting Grassmann variables on the one hand and commuting c-number spinors on the other. We consider both real and complex Grassmann variables and map the equations of motion and the supersymmetry transformation from one theory to another. The more intuitive c-number theory allows us to generalize the notion of Zitterbewegung to strings and membranes. (A hidden supersymmetry exists in the classical model of the Dirac electron.) (author). 12 refs.

47897 **(IC—88/84) Generalized solutions of stochastic evolution equations.** Gorostiza, L.G.; Dawson, D.A. (International Centre for Theoretical Physics, Trieste (Italy); Carleton Univ., Ottawa, Ontario (Canada)). (International Centre for Theoretical Physics, Trieste (Italy)). May 1988. 15p. NTIS (US Sales Only), PC A03/MF A01. Order Number DE88703858/JAW.

The generalized solutions of evolution equations for Gaussian processes are discussed and a few examples are given. 11 refs.

47898 (INIS-BR—1164, pp 61) **Boundary condition effect on the Blume-Capel quantum chain spectrum.** Balbao, D.B.; Felicio, J.R.D. de. (Sao Paulo Univ., Sao Carlos, SP (Brazil). Inst. de Fisica e Quimica). 1987. (In Portuguese). NTIS (US Sales Only), PC A09/MF A01. Order Number DE88703566/JAW. (CONF-8705181—).

From 10. national meeting on condensed matter physics; Caxambu, Brazil (5 May 1987).

47899 (INIS-BR—1164, pp 62) **Brownian motion.** Smith, C.M.; Caldeira, A.O. (Universidade Estadual de Campinas (Brazil). Inst. de Fisica). 1987. (In Portuguese). NTIS (US Sales Only), PC A09/MF A01. Order Number DE88703566/JAW. (CONF-8705181—).

From 10. national meeting on condensed matter physics; Caxambu, Brazil (5 May 1987).

47900 (INIS-BR—1164, pp 62) **Statistical mechanics of a 2D random cellular structure.** Almeida, R.M.C. de; Iglesias-Sicardi, J.R. (Rio Grande do Sul Univ., Porto Alegre (Brazil). Inst. de Fisica). 1987. (In Portuguese). NTIS (US Sales Only), PC A09/MF A01. Order Number DE88703566/JAW. (CONF-8705181—).

From 10. national meeting on condensed matter physics; Caxambu, Brazil (5 May 1987).

47901 (INIS-BR—1164, pp 62) **Kobayashi model dynamics with anharmonic correction by the Mori's continued fraction method.** Sa Motta, C.E.H. de; Pires, A.S.T. (Universidade Federal de Ouro Preto (Brazil). Dept. de Fisica; Minas Gerais Univ., Belo Horizonte (Brazil)). 1987. (In Portuguese). NTIS (US Sales Only), PC A09/MF A01. Order Number DE88703566/JAW. (CONF-8705181—).

From 10. national meeting on condensed matter physics; Caxambu, Brazil (5 May 1987).

47902 (INIS-BR—1164, pp 11) **Study of two-dimensional integrable systems with quartic invariants.** Beims, M.W.; Gallas, J.A.C. (Santa Catarina Univ., Florianopolis (Brazil). Dept. de Fisica). 1987. (In Portuguese). NTIS (US Sales Only), PC A09/MF A01. Order Number DE88703566/JAW. (CONF-8705181—).

From 10. national meeting on condensed matter physics; Caxambu, Brazil (5 May 1987).

47903 (INIS-BR—1164, pp 11) **Duality between quantum systems.** Cabral, F.; Gallas, J.A.C. (Santa Catarina Univ., Florianopolis (Brazil). Dept. de Fisica). 1987. (In Portuguese). NTIS (US Sales Only), PC A09/MF A01. Order Number DE88703566/JAW. (CONF-8705181—).

From 10. national meeting on condensed matter physics; Caxambu, Brazil (5 May 1987).

47904 (INIS-BR—1164, pp 11) **Dyronium quantization by the trajectory integral method.** Cheng, B.K. (Parana Univ., Curitiba (Brazil). Dept. de Fisica). 1987. (In Portuguese). NTIS (US Sales Only), PC A09/MF A01. Order Number DE88703566/JAW. (CONF-8705181—).

From 10. national meeting on condensed matter physics; Caxambu, Brazil (5 May 1987).

47905 (INIS-BR—1164, pp 12) **Stationary states of two Dirac particles in a Coulombian center.** Yamamoto, J.F.; Agostinho Neto, A. (Sao Paulo Univ. (Brazil). Inst. de Fisica). 1987. (In Portuguese). NTIS (US Sales Only), PC A09/MF A01. Order Number DE88703566/JAW. (CONF-8705181—).

From 10. national meeting on condensed matter physics; Caxambu, Brazil (5 May 1987).

47906 (INIS-BR—1164, pp 51) **Analytical solution of the one-dimensional Schroedinger equation.** Monaco, R.E.L.; Oyarzun, G.G.C. (Universidade Estadual de Campinas (Brazil). Inst. de Fisica). 1987. (In Portuguese). NTIS (US Sales Only), PC A09/MF A01. Order Number DE88703566/JAW. (CONF-8705181—).

From 10. national meeting on condensed matter physics; Caxambu, Brazil (5 May 1987).

47907 (INIS-BR—1164, pp 51) **Nonlinear excitations in disordered magnetic systems.** Cordeiro, C.E. (Universidade Federal Fluminense, Niteroi (Brazil). Inst. de Fisica). 1987. (In Portuguese). NTIS (US Sales Only), PC A09/MF A01. Order Number DE88703566/JAW. (CONF-8705181—).

From 10. national meeting on condensed matter physics; Caxambu, Brazil (5 May 1987).

47908 (INIS-BR—1164, pp 55) **Thermodynamic properties of an ideal ultrarelativistic Bose gas in parastatistics.** Silva, M.S.; Frota, H.O. da; Rosa Junior, S.G. (Amazonas Univ., Manaus (Brazil); Sao Paulo Univ., Sao Carlos, SP (Brazil). Inst. de Fisica e Quimica). 1987. (In Portuguese). NTIS (US Sales Only), PC A09/MF A01. Order Number DE88703566/JAW. (CONF-8705181—).

From 10. national meeting on condensed matter physics; Caxambu, Brazil (5 May 1987).

47909 (INIS-BR—1164, pp 56) **Entropy and the entropy flux for a two-atomic gas.** Kremer, G.M. (Parana Univ., Curitiba (Brazil). Dept. de Fisica). 1987. (In Portuguese). NTIS (US Sales Only), PC A09/MF A01. Order Number DE88703566/JAW. (CONF-8705181—).

From 10. national meeting on condensed matter physics; Caxambu, Brazil (5 May 1987).

47910 (INIS-BR—1164, pp 59) **Chaotic dynamical evolution from universal attractor coalescence.** Celaschi, S.; Zimmerman, R.L. (Sao Paulo Univ., Sao Carlos (Brazil). Escola de Engenharia; 8950064BR). 1987. (In Portuguese). NTIS (US Sales Only), PC A09/MF A01. Order Number DE88703566/JAW. (CONF-8705181—).

From 10. national meeting on condensed matter physics; Caxambu, Brazil (5 May 1987).

47911 (INIS-BR—1164, pp 60) **Study of "accumulation points" in a Frenkel-Kontorowa model with perturbed potential.** Yokoi, C.S.O. (Sao Paulo Univ. (Brazil). Inst. de Fisica). 1987. (In Portuguese). NTIS (US Sales Only), PC A09/MF A01. Order Number DE88703566/JAW. (CONF-8705181—).

From 10. national meeting on condensed matter physics; Caxambu, Brazil (5 May 1987).

47912 (INIS-BR—1164, pp 63) **Quantum correction of the soliton mass in the TMMC.** Talim, S.L.; Pires, A.S.T. (Minas Gerais Univ., Belo Horizonte (Brazil). Dept. de Fisica). 1987. (In Portuguese). NTIS (US Sales Only), PC A09/MF A01. Order Number DE88703566/JAW. (CONF-8705181—).

From 10. national meeting on condensed matter physics; Caxambu, Brazil (5 May 1987).

47913 (INIS-BR—1164, pp 68) **Exchange operator for high order spins.** Bastos Filho, J.B. (Alagoas Univ., Maceio (Brazil). Dept. de Fisica). 1987. (In Portuguese). NTIS (US Sales Only), PC A09/MF A01. Order Number DE88703566/JAW. (CONF-8705181—).

From 10. national meeting on condensed matter physics; Caxambu, Brazil (5 May 1987).

47914 (INIS-BR—1164, pp 162) **Interstitial titanium in silicon.** Martins, G.B.; Barberis, G.E. (Universidade Estadual de Campinas (Brazil). Inst. de Fisica). 1987. (In Portuguese). NTIS (US Sales Only), PC A09/MF A01. Order Number DE88703566/JAW. (CONF-8705181—).

From 10. national meeting on condensed matter physics; Caxambu, Brazil (5 May 1987).

47915 (INIS-BR—1164, pp 163) **Electronic states in configuration of crossed fields - (ExB).** Chitta, V.A.; Cohen, A.M. (Sao Paulo Univ., Sao Carlos, SP (Brazil). Inst. de Fisica e Quimica). 1987. (In Portuguese). NTIS (US Sales Only), PC A09/MF A01. Order Number DE88703566/JAW. (CONF-8705181—).

From 10. national meeting on condensed matter physics; Caxambu, Brazil (5 May 1987).

47916 (INIS-BR—1164, pp 172) **Energy of ground state of electron gas in quantum well of GaAs-Al/sub x/ Ga/sub 1-x/ As.** Freitas, U. de; Degani, M.H. (Paraiba Univ., Joao Pessoa (Brazil); Sao Paulo Univ., Sao Carlos, SP (Brazil). Inst. de Fisica e Quimica). 1987. (In Portuguese). NTIS (US Sales Only), PC A09/MF A01. Order Number DE88703566/JAW. (CONF-8705181—).

From 10. national meeting on condensed matter physics; Caxambu, Brazil (5 May 1987).

47917 (INIS-BR—1164, pp 172) **Diagonal and non-diagonal disorders in doped quantum wells.** Andrada e Silva, E.A. de; Cunha Lima, I.C. da; Leal, C.E.S.; Silva, A.F. da. (Instituto de Pesquisas Espaciais, Sao Jose dos Campos (Brazil)). 1987. (In Portuguese). NTIS (US Sales Only), PC A09/MF A01. Order Number DE88703566/JAW. (CONF-8705181—).

From 10. national meeting on condensed matter physics; Caxambu, Brazil (5 May 1987).

47918 (INIS-BR—1164, pp 176) **Band of impurities in indirect gap semiconductors.** Figueira, M.S.; Makler, S.S.; Anda, E.V. (Universidade Federal Fluminense, Niteroi (Brazil)). 1987. (In Portuguese). NTIS (US Sales Only), PC A09/MF A01. Order Number DE88703566/JAW. (CONF-8705181—).

From 10. national meeting on condensed matter physics; Caxambu, Brazil (5 May 1987).

47919 (INIS-mf—11287) **Studies in geometric quantization.** Tuynman, G.M. (Amsterdam Univ. (Netherlands)). 3 Feb 1988. 176p. NTIS (US Sales Only), PC A09/MF A01. Order Number DE88703907/JAW.

Contains summary in Dutch and previously published material.

This thesis contains five chapters, of which the first, entitled 'What is prequantization, and what is geometric quantization?', is meant as an introduction to geometric quantization for the non-specialist. The second chapter, entitled 'Central extensions and physics' deals with the notion of central extensions of manifolds and elaborates and proves the statements made in the first chapter. Central extensions of manifolds occur in physics as the freedom of a phase factor in the quantum mechanical state vector, as the phase factor in the prequantization process of classical mechanics and it appears in mathematics when studying central extension of Lie groups. In this chapter the connection between these central extensions is investigated and a remarkable similarity between classical and quantum mechanics is shown. In chapter three a classical model is given for the hydrogen atom including spin-orbit and spin-spin interaction. The method of geometric quantization is applied to this model and the results are discussed. In the final chapters (4 and 5) an explicit method to calculate the operators corresponding to classical observables is given when the phase space is a Kaehler manifold. The obtained formula are then used to quantise symplectic manifolds which are irreducible hermitian symmetric spaces and the results are compared with other quantization procedures applied to these manifolds (in particular to Berezin's quantization). 91 refs.; 3 tabs.

47920 (SLAC-PUB—4526) **Foundations of a discrete physics.** McGoveran, D.; Noyes, P. (Stanford Linear Accelerator Center, Menlo Park, CA (USA)). Jan 1988. Contract AC03-76SF00515. 104p. (CONF-8709318—2). NTIS, PC A04/MF A01; 1; GPO Dep. Order Number DE88015341/JAW.

From 9. annual international meeting of the Alternative Natural Philosophy Association; Cambridge, UK (23 Sep 1987).

Starting from the principles of finiteness, discreteness, finite computability and absolute nonuniqueness, we develop the ordering operator calculus, a strictly constructive mathematical system having the empirical properties required by quantum mechanical and special relativistic phenomena. We show how to construct discrete distance functions, and both rectangular and spherical coordinate systems(with a discrete version of "π"). The richest discrete space constructible without a preferred axis and preserving translational and rotational invariance is shown to be a discrete 3-space with the usual symmetries. We introduce a local ordering parameter with local (proper) time-like properties and universal ordering parameters with global (cosmological) time-like properties. Constructed "attribute velocities" connect ensembles with attributes that are invariant as the appropriate time-like parameter increases. For each such attribute, we show how to construct attribute velocities which must satisfy the " relativistic Doppler shift" and the "relativistic velocity composition law," as well as the Lorentz transformations. By construction, these velocities have finite maximum and minimum values. In the space of all attributes, the minimum of these maximum velocities will predominate in all multiple attribute computations, and hence can be identified as a fundamental limiting velocity, General commutation relations are constructed which under the physical interpretation are shown to reduce to the usual quantum mechanical commutation relations. 50 refs., 18 figs.

47921 **Supersymmetry and bistable soft potentials.** Marchesoni, F.; Sodano, P.; Zannetti, M. (Department of Physics, Boston University, Boston, Massachusetts 02215). *Physical Review Letters;* **61**: No. 10, 1143-1146(5 Sep 1988).

The diffusion of a Brownian particle is investigated for a class of potentials (soft bistable) which resist conventional techniques. A new method of solution based on supersymmetric quantum mechanics is shown to provide with minimal effort an accurate determination of the small eigenvalue of the relevant Fokker-Planck equation. The reciprocal of the small eigenvalue compares very closely with a refined definition of mean first-passage time.

47922 **Extraction of ground state properties by discretized path integral formulations.** Kono, H.; Takasaka, A.; Lin, S.H. (Department of Basic Technology, Faculty of Engineering, Yamagata University, Yonezawa 992, Japan). *Journal of Chemical Physics;* **89**: No. 5, 3233-3239(1 Sep 1988).

We offer a way of determining the temperature range in which a path integral (PI) formulation of the quantum partition function works well and a way of calculating the ground state properties without employing extremely low temperatures (in order to elude the awkward problem that the quantities calculated by the PI formulation become inaccurate with decreasing temperature owing to unavoidable truncation of an infinite number of path integral variables). The fact that the PI energy, specific heat, etc. behave in a low temperature range against physical laws makes it possible to locate the "marginal" temperature at which the PI specific heat begins to grow infinitely and to estimate the lowest temperature at which the PI formulation functions well (the "threshold temperature"). Whether or not the threshold temperature is low enough to extract only the ground state properties can be answered by either checking if the PI energy and free energy are equal at the threshold temperature or checking if the PI specific heat is relatively small thereat. If the system is in the ground state at the threshold temperature obtained, it is recommended to calculate the ground state properties at this temperature. This scheme can be executed by Monte Carlo methods, being open to many-particle systems. Using the discretized PI formulations, we apply the above procedure to a harmonic oscillator and a double-well potential. It is concluded that this scheme is successful at least as long as the potential is a slowly varying function of coordinates.

47923 **Ricci curvature of Diff S^1/SL(2,R).** Bowick, M.J.; Lahiri, A. (Physics Department, Syracuse University, Syracuse, New York 13244-1130). *Journal of Mathematical Physics (New York);* **29**: No. 9, 1979-1981(Sep 1988).

Previous calculations of the Ricci curvature for the manifold Diff Diff(S^1)/S^1 are extended to Diff(S^1)/SL(2R). These manifolds are distinguished by being coadjoint orbits of Diff(S^1) which admit compatible symphectic and complex structures, making them Kaehler manifolds.

47924 **Missing mass really missing?.** Visser, M. (Univ. of Southern California, Los Angeles (USA)). *General Relativity and Gravitation;* **20**: No. 1, 77-82(Jan 1988). Contract FG03-84ER40168.

The authors have no experimental evidence for the validity of the inverse square law for gravitation at distances significantly

larger than the diameter of the solar system. This raises the very real possibility that the missing mass (dark matter) may not exist. Instead, the inverse square law may be breaking down at distances of the order of tens of kiloparsecs. The author discusses this possibility within the framework of Scalar-Vector-Tensor (SVT) theories of gravity. It appears to be relatively easy to account for up to approximately 10% of the galactic halo dark matter via SVT theories of gravity. With some fine-tuning of parameters, it is conceivable that all of the dark matter can be accounted for in this way.

70 FUSION ENERGY

7001 Plasma Research

REFER ALSO TO CITATION(S) 47453, 47980

47925 (CTH-ED—167) Curvature driven instabilities in toroidal plasmas. Andersson, P. (Chalmers Univ. of Tech., Goeteborg (Sweden). School of Electrical Engineering; Chalmers Univ. of Tech., Goeteborg (Sweden). Inst. for Electromagnetic Field Theory and Plasma Physics). Nov 1986. 21p. (CTH-IEFT-ED—167). NTIS (US Sales Only), PC A03/MF A01. Order Number DE88753649/JAW.

The electromagnetic ballooning mode, the curvature driven trapped electron mode and the toroidally induced ion temperature gradient mode have been studies. Eigenvalue equations have been derived and solved both numerically and analytically. For electromagnetic ballooning modes the effects of convective damping, finite Larmor radius, higher order curvature terms, and temperature gradients have been investigated. A fully toroidal fluid ion model has been developed. It is shown that a necessary and sufficient condition for an instability below the MHD limit is the presence of an ion temperature gradient. Analytical dispersion relations giving results in good agreement with numerical solutions are also presented. The curvature driven trapped electron modes are found to be unstable for virtually all parameters with growth rates of the order of the diamagnetic drift frequency. Studies have been made, using both a gyrokinetic ion description and the fully toroidal ion model. Both analytical and numerical results are presented and are found to be in good agreement. The toroidally induced ion temperature gradients modes are found to have a behavior similar to that of the curvature driven trapped electron modes and can in the electrostatic limit be described by a simple quadratic dispersion equation.

47926 (CTH-ED—168) Heating and diagnostics in DT-fusion plasma. Pekkari, L.O. (Chalmers Univ. of Tech., Goeteborg (Sweden). School of Electrical Engineering; Chalmers Univ. of Tech., Goeteborg (Sweden). Inst. for Electromagnetic Field Theory and Plasma Physics). Nov 1986. 31p. (CTH-IEFT-ED—168). NTIS (US Sales Only), PC A03/MF A01. Order Number DE88753650/JAW.

This thesis addresses two issues of significance for the fusion research. The first issue is the supplementary heating of fusion plasmas. Supplementary heating is expected to produce a substantial increase in plasma temperature in the present generation of fusion experiments. The second issue concerns the availability of reliable diagnostics for high temperature plasma. Accurate diagnostics will be increasingly important for the understanding of hot fusion plasmas. The results of the present thesis should have implications on several types of fusion plasmas although the emphasis is on the DT-plasmas, i.e., plasma consisting of a mixture of deterium and tritium. These types of plasmas are of interest for the present and the next generation of fusion experiments, such as JET in Europe TFTR in USA. These experiments are expected to reach temperatures, densities and confinement times close to those needed for ignition in a DT-plasma. It is shown that RF-heating may be efficiently used in combination with neutral-beam heating and that increased power absorption as well as increased power multiplication in DT-plasmas may result from this combined neutral-beam and RF-heating. It is also shown that temperatures above 5 keV can be accurately measured with reasonable efficiency by a neutron spectrometer based on the combined proton-recoil and neutron time-of-flight method.

47927 (CTH-IEFT-PP—1987-02) Nonlinear cascade processes in magnetized plasma with temperature anisotropy. Liljestroem, M.; Weiland, J. (Chalmers Univ. of Tech., Goeteborg (Sweden). Inst. for Electromagnetic Field Theory and Plasma Physics). 1987. 27p. NTIS (US Sales Only), PC A03/MF A01. Order Number DE88753651/JAW.

A simplified nonlinear gyrokinetic formalism has been developed for general distribution functions and general magnetic perturbations. It has been found that the nonlinear coupling strength for low frequency electromagnetic modes in plasma with unisotropic temperature is larger than for the isotropic case for small Larmor radius. A nonlinear cascade where the pump mode is the mode with intermediate parallel phase velocity has been found. (authors). With 25 refs.

47928 (DOE/ER/53221—3) Maryland Controlled Fusion Research Program: Progress report, November 1, 1987-July 1, 1988. (Maryland Univ., College Park (USA). Lab. for Plasma Research). 1988. Contract FG05-86ER53221. 17p. NTIS, PC A03/MF A01; 1; GPO Dep. Order Number DE88014121/JAW.

In recent years, members of the Maryland Theory Group have made significant contributions to the national fusion theory programs, and, in many cases, these theoretical developments helped to interpret experimental results and to design new experimental programs. In the following, we summarize the technical progress in five major areas: sawteeth in tokamaks; density limit disruptions in tokamaks; anomalous transport in tokamaks; compact torus and RFP studies; stability theory of tokamaks and other configurations; cyclotron radiation from current driven tokamaks; and atomic physics.

47929 (DOE/ER/53222—98) ICRF [Ion Cyclotron Range of Frequencies] heating and antenna coupling in a high beta tokamak. Elet, R.S. (Columbia Univ., New York (USA)). 1988. Contract FG02-86ER53222;AC02-76CH03073. 141p. NTIS, PC A07/MF A01; 1; GPO Dep. Order Number DE88015064/JAW.

Maxwell's Equations are solved in two-dimensions for the electromagnetic fields in a toroidal cavity using the cold plasma fluid dielectric tensor in the Ion Cyclotron Range of Frequencies (ICRF). The Vector Wave Equation is transformed to a set of two, coupled second-order partial differential equations with inhomogeneous forcing functions which model a wave launcher. The resulting equations are finite differenced and solved numerically with a complex banded matrix algorithm on a Cray-2 computer using a code described in this report. This code is used to study power coupling characteristics of a wave launcher for low and high beta tokamaks. The low and high beta equilibrium tokamak magnetic fields applied in this model are determined from analytic solutions to the Grad-Shafranov equation. The code shows good correspondence with the results of low field side ICRF heating experiments performed on the Tokamak of Fontenay-Aux-Roses (TFR). Low field side and high field side antenna coupling properties for ICRF heating in the Columbia High Beta Tokamak (HBT) experiment are calculated with this code. Variations of antenna position in the tokamak, ionic concentration and plasma density, and volume-averaged beta have been analyzed for HBT. It is found that the location of the antenna with respect to the plasma has the dominant role in the design of an ICRF heating experiment in HBT. 10 refs., 52 figs., 13 tabs.

47930 (DOE/ER/53223—68) Anomalous transport arising from nonlinear resistive pressure-driven modes in a plasma. Hamaguchi, Satoshi. (New York Univ., NY (USA). Courant Inst. of Mathematical Sciences). May 1988. Contract FG02-86ER53223. 106p. (MF—117). NTIS, PC A06/MF A01; 1; GPO Dep. Order Number DE88014984/JAW.

Anomalous transport caused by fluctuations of resistive pressure-driven modes is discussed within the framework of magnetohydrodynamics (MHD). The nonlinear reduced equations describing fluctuations localized near a particular magnetic field line are derived for tokamak and reversed-field-pinch (RFP) plasmas, taking into account nonzero viscosity and heat conductivity. Based on the reduced equations, the relationship between the dynamo effect, or

the electric field caused by the fluctuations, and the anomalous heat transport is obtained. For an ideally stable but resistively slightly unstable plasma, the anomalous transport is caused particularly by convective motions. The convection is studied as bifurcation from the linearly unstable equilibrium and the expression of the anomalous transport in a tokamak plasma is obtained as a function of the mean pressure gradient near the critical point. In order to evaluate the effects of the convection on the anomalous transport under various conditions, the reduced equations are also solved numerically. It is found that the Nusselt number, that is, the ratio of the total heat conductivity including the anomalous heat transport to the classical collisional heat conductivity, is significantly large under some conditions. This partially explains the large heat losses in controlled thermonuclear fusion devices. 24 refs., 7 figs.

47931 **(DOE/ER/53252—6-Pt.2) Zero-dimensional calculations for 2 MA operation of ZT-H.** Klevans, E.H.; Veerasingam, R. (Pennsylvania State Univ., University Park (USA). Dept. of Nuclear Engineering). 22 Jul 1988. Contract FG02-87ER53252. 6p. NTIS, PC A02/MF A01; 1; GPO Dep. Order Number DE88014642/JAW.

This report, which presents simulation results for 2 MA operation of ZT-H, is a continuation of the Report DOE/ER/53256--6 which described computer simulations for 4 MA operation of ZT-H. The significant results are presented in Tables, which show values of T, β/sub θ/, Z/sub eff/, {tau}/sup L/, P/sub Rad/, and P/sub OH/ at the end of the 2 MA run. Here, {tau}/sub L/ is the total energy loss time. 8 tabs.

47932 **(ENEA-RT-FUS—86-14) Resistive electrostatic instabilites.** Tang, W.M.; Romanelli, F.; Briguglio, S. (ENEA, Rome (Italy)). Mar 1988. 32p. NTIS (US Sales Only), PC A03/MF A01. Order Number DE88754238/JAW.

The stability properties of current driven modes are investigated. The equation for electrostatic potential is analytically solved in slab geometry, both in the strongly collisional and semicollisional regimes. Particular interest is focused on the impurity driven mode which can be relevant for situations typically evidenced at the edge of a tokamak. A set of toroidal equations is derived and analyzed in the strongly collisional limit and its relevance in the explanation of edge transport is discussed.

47933 **(ENEA-RT-FUS—87-20) High resolution X-ray spectroscopy at JET.** Giannella, R. (ENEA, Rome (Italy)). Dec 1987. 12p. (CONF-8709143—4). NTIS (US Sales Only), PC A03/MF A01. Order Number DE88754231/JAW.

From International colloquium on UV and X-ray spectroscopy; Beaulieu-Sur-Mer, France (9 Sep 1987).

A high resolution X-ray crystal spectrometer was installed at JET in 1986. The main task of this instrument, designed and built by the ENEA Frascati Laboratory in collaboration with JET, was the measurement of the ion temperature and rotation velocity from Doppler broadenings and shifts. Stringent operation requirements considerably conditioned its versatility as a survey instrument or a tool for fundamental research. The unique conditions of the JET plasmas, however, allowed the observation, with high resolution, and identification of lines from the highest ionization stages (B-like to H-like) of nickel in the vicinity of the resonance transitions of the one-and two-electron systems of this element. These spectra and their relevance to the study of JET physics were briefly presented in this report. A comparison was made with atomic physics theoretical computations of He-like and H-like ion spectra observed at JET. The most intense lines were regularly monitored with adequate time resolution as to allow the production of an extensive data base. The experimental spectra were simulated by integrating the theoretical ones along the spectrograph line of sight across the plasma. Ion temperature, as well as, rotation velocity measurements, in ohmic plasmas and additionally heated ones, were discussed and their relationship with other physical quantities and operational parameters, reviewed. The spectrometer design, its layout at the JET site and its operational capabilities, were detailed.

47934 **(IC—88/83) Possible parametric instabilities of beat waves in a transversely magnetized plasma.** Salimullah, M. (International Centre for Theoretical Physics, Trieste (Italy)). May 1988. 40p. NTIS (US Sales Only), PC A03/MF A01. Order Number DE88703857/JAW.

The effect of an external magnetic field on the various possible parametric instabilities of the longitudinal beat wave at the difference frequency of two incident laser beams in a hot plasma has been thoeretically investigated. The kinetic equation is employed to obtain the nonlinear response of the magnetized electrons due to the nonlinear coupling of the beat wave with the low-frequency electrostatic plasma modes. It is noted that the growth rates of the three-wave and the four-wave parametric instabilities can be influenced by the external transverse magnetic field. (author). 20 refs, 3 figs.

47935 (INIS-BR—1164, pp 59) **Question of experimental signal analysis for the deterministic chaos evidence.** Fiedler-Ferrari, N. (Sao Paulo Univ. (Brazil). Inst. de Fisica). 1987. (In Portuguese). NTIS (US Sales Only), PC A09/MF A01. Order Number DE88703566/JAW. (CONF-8705181—).

From 10. national meeting on condensed matter physics; Caxambu, Brazil (5 May 1987).

47936 **(INIS-BR—1206) Study on performance of a simultaneous spectrometer of ICP emission source for the determination of the major elements in rocks.** Vieira, M.D. (Pontificia Univ. Catolica do Rio de Janeiro (Brazil). Dept. de Quimica). 1987. 188p. (In Portuguese). NTIS (US Sales Only), PC A09/MF A01. Order Number DE88703897/JAW.

The optimization of operational parameters of a simultaneous spectrometer coupled to an ICP excitation source in order to establish an analytical method for the simultaneous determination of the major elements in rocks is studied. The mutual spectral interferences, calibration curves for the acid and saline matrix and the internal standard method with ytrium are analyzed. (M.J.C.).

47937 **(IPP—5/17) Maximum bootstrap current compatible with ballooning-stable pressure profiles.** Lackner, K. (Max-Planck-Institut fuer Plasmaphysik, Garching (Germany, F.R.)). Nov 1987. 10p. NTIS (US Sales Only), PC A02/MF A01. Order Number DE88754599/JAW.

Assuming a given ratio of logarithmic temperature gradient and density grandient, the local current density of the bootstrap current in the tokamak plasma is proportional to the pressure gradient and hence is subject to the limits imposed by ideal ballooning modes. This paper therefore investigates the maximum contribution to the total plasma current that can be expected from the bootstrap current under the condition of MHD stability, after external injection of a non-inductively driven seed current. For the evaluation of the ballooning mode criterion, the so-called s-α model of a tokamak with the geometry of a circular flux surfaces is used, taking into account other modes only through limiting the safety factor q everywhere to values $\geq$ 1. Assuming favourable values for density and temperature profiles (d log T/d log n=1), a maximum contribution of the bootstrap current is calculated for an aspect ratio of 3, which amounts to 50% with q/sub a/ = 2, or to 66% with q/sub a/ = 3.

47938 **(IYF-R—6-294) Energy spectra of ions at the stage of inertial expansion of laser plasma.** Bedilov, M.R.; Sultanov, Sh.D.; Khabibullaev, B.K.; Kholbaev, A.; Tsoj, T.G. (AN Uzbekskoj SSR, Tashkent. Inst. Yadernoj Fiziki). 1987. 11p. (In Russian). NTIS (US Sales Only), PC A03/MF A01. Order Number DE88703644/JAW.

The change of ion energy spectra is considered at the stage of inertial expension of laser plasma. Ion spectra obtained at a distance of 6 cm from the target using collector method are compared with those from mass spectrometric measurements when flight distance was equal to 150 cm. 9 refs.; 6 figs.

47939 **(JET-R—87-12) Effects on doppler profiles in beam-heated plasmas.** Fussmann, G. (Commission of the European Communities, Abingdon (UK). JET Joint Undertaking). 1988. 35p. NTIS (US Sales Only), PC A03/MF A01. Order Number DE88754287/JAW.

We analyze various effects that can influence ion temperature measurements based on Doppler broadening of impurity lines. Macroscopic effects such as inhomogeneities, plasma rotation and temporal modulations are distinguished from microscopic ones leading to species-dependent temperatures and anisotropy in the impurity distribution functions. There are turbulent effects related to the latter that can also cause deviations from thermodynamic equilibrium among light and heavy impurities. It is found that under neutral-beam-heated JET conditions, all effects should be small and influence the measured ion temperature by less than ~ 10%. Larger influences could be expected from strongly peaked rotation profiles - for which, however, no indications are found - and high-level turbulence, which appears rather unrealistic, too.

47940 **(JET-R—88-02) Neoclassical current and transport in auxiliary heated tokamaks.** Kim, Y.B.; Callen, J.D.; Hamnen, H. (Commission of the European Communities, Abingdon (UK). JET Joint Undertaking). Jan 1988. 27p. NTIS (US Sales Only), PC A03/MF A01. Order Number DE88754288/JAW.

A generalized Ohm's law is derived which includes the neoclassical Spitzer current, the Pfirsch-Schlueter current, the bootstrap current, and the fast-ion-induced current, including trapped-particle effects. Also, the additional neoclassical radial transport induced by the parallel momentum and heat flow inputs from the fast ion tail are determined. Detailed expressions for these transport coefficients are derived for a tokamak in the banana collisionality regime for a magnetic geometry of arbitrary aspect ratio with an elliptical plasma cross section. The magnitudes of the various possible effects are illustrated by calculations for high power auxiliary heating in JET.

47941 **(N—88-23649) Space plasma contactor research, 1987. Annual report, 1 January 1987-1 January 1988.** Wilbur, P.J. (Colorado State Univ., Fort Collins (USA)). Jan 1988. 87p. (NASA-CR—182148; NAS—1.26:182148). NTIS, PC A05/MF A01.

A simple model describing the process of electron collection from a low pressure ambient plasma in the absence of magnetic field and contactor velocity effects is presented. Experimental measurments of the plasma surrounding the contactor are used to demonstrate that a double-sheath generally develops and separates the ambient plasma from a higher density, anode plasma located adjacent to the contactor. Agreement between the predictions of the model and experimental measurements obtained at the electron collection current levels ranging to 1 A suggests the surface area at the ambient plasma boundary of the double-sheath is equal to the electron current being collected divided by the ambient plasma random electron current density; the surface area of the higher density anode plasma boundary of the double-sheath is equal to the ion current being emitted across this boundary divided by the ion current density required to sustain a stable sheath; and the voltage drop across the sheath is determined by the requirement that the ion and electron currents counterflowing across the boundaries be at space-charge limited levels. The efficiency of contactor operation is shown to improve when significant ionization and excitation is induced by electrons that stream from the ambient plasma through the double-sheath and collide with neutral atoms being supplied through the hollow cathode.

47942 **Nonlinear gyrokinetic equations for tokamak microturbulence.** Hahm, T.S. (Plasma Physics Laboratory, Princeton University, Princeton, New Jersey 08543). *Physics of Fluids;* 31: No. 9, 2670-2673(Sep 1988).

A nonlinear electrostatic gyrokinetic Vlasov equation as well as a Poisson equation have been derived in a form suitable for particle simulation studies of tokamak microturbulence and associated anomalous transport. This work differs from the existing nonlinear gyrokinetic theories in toroidal geometry, since the present equations conserve energy while retaining the crucial linear and nonlinear polarization physics. In the derivation, the action-variational Lie perturbation method is utilized in order to preserve the Hamiltonian structure of the original Vlasov—Poisson system. Emphasis is placed on the dominant physics of the collective fluctuations in toroidal geometry, rather than on details of particle orbits.

47943 **Theory of trapped-ion-temperature-gradient-driven turbulence and transport in low-collisionality plasmas.** Biglari, H.; Diamond, P.H.; Terry, P.W. (Institute for Fusion Studies, University of Texas, Austin, Texas 78712-1080). *Physics of Fluids;* 31: No. 9, 2644-2658(Sep 1988).

A novel theory for the nonlinear evolution of the trapped-ion-temperature-gradient-driven mode, based on the turbulent trapping of resonant ions in the electrostatic potential of the waves, is proposed. A statistical description is adopted whereby the self-consistent evolution of the two-point correlation function of the trapped-particle distribution function is followed in phase space. Threshold-dependent, non-steady-state turbulence (nonlinear instability) is shown to develop when the decay of the correlation function is overcome by a source term that derives its free energy from the relaxation of the average distribution function. This nonlinear instability leads to anomalous thermal and particle transport that in turn reconfigure the equilibrium temperature and density profiles in such a way as to return the system toward its marginal point. Expressions for the nonlinear dispersion relation and threshold, as well as estimates of the thermal and particle transport level, are derived. The estimated flux levels are sufficiently high as to make any significant departure away from marginality unlikely. The scenario outlined serves to underscore the desirability for pellet injection in experimental devices such as the Compact Ignition Tokamak [Bull. Am. Phys. Soc. 32, 1921 (1987)] that operate in the very low ion collisionality regime where this mode would be expected to become relevant. As with a number of recent theories, the present work further reinforces the notion that unfavorably drifting trapped particles pose a serious menace to confinement and suggests inboard, off-axis radio-frequency heating as one means of reducing the size of this population, at least for the case of those energetic trapped particles created during auxiliary heating.

47944 **Effects of collisions on the trapped particle mode in a linear machine.** Mathey, O.; Sen, A.K. (Department of Applied Physics and Nuclear Engineering, Columbia University, New York, New York 10027). *Physics of Fluids;* 31: No. 9, 2695-2703(Sep 1988).

The effects of weak Coulomb and neutral collisions on the collisionless curvature driven trapped particle mode are studied in the Columbia Linear Machine [Phys. Rev. Lett. 57, 1729(1986)] by means of particle-conserving Krook and Fokker—Planck operators. Both types of collisionality are then combined, modeling neutral collisions with the conserving Krook and Coulomb collisions with a Lorentz model. The dispersion relation is then integrated over velocity space. Low Coulomb collisionality yields a small stabilizing correction to the magnetohydrodynamic collisionless mode, which scales as $\nu/\mathrm{sub}\ e/$ using the Krook model and $\nu/\mathrm{sup}\ 1/2//\mathrm{sub}\ e//\mathrm{sub}\ C/$ using a Lorentz pitch-angle operator. In higher collisionality regimes, both models tend to yield similar scalings.

47945 **Experimental investigation of a coherent flute instability using a heavy ion beam probe.** Glowienka, J.C.; Jennings, W.C.; Hickok, R.L. (Oak Ridge National Laboratory, Oak Ridge, Tennessee 37831). *Physics of Fluids;* 31: No. 9, 2704-2709(Sep 1988).

A coherent, low-frequency instability found in a cylindrical, hollow cathode arc plasma has been investigated by using a heavy ion beam probe (HIBP). The energy density of the plasma was high enough to render it inaccessible to Langmuir probes, but the HIBP was able to provide measurements throughout the plasma cross section. The data clearly show that azimuthal symmetry does not exist. Radial profiles of steady-state density and space potential and of simultaneous n-italic-tilde, phi-tilde amplitude and phase were obtained to allow detailed comparison between theory and experiment. Predictions from a cylindrically symmetric, small-perturbation theoretical model provide reasonably conclusive identification of the instability as a Kelvin—Helmholtz flute driven by and localized in a region of fluid shear. The most serious discrepancy was with regard to the oscillation frequency, which was consistently

predicted to be three to four times lower than that observed experimentally. The reason for the discrepancy is not understood, but it is probably related to inadequacies in the theory caused by assumptions of azimuthal symmetry and of small linear perturbations.

47946 **Diamagnetic drift effects on ion Bernstein mode propagation in a plasma slab.** Ferraro, R.D.; Fried, B.D. (Department of Physics, University of California, Los Angeles, California 90024-1547). *Physics of Fluids;* **31**: No. 9, 2594-2601(Sep 1988).

A one-dimensional infinite-order differential equation that describes the propagation of small amplitude electrostatic waves through a uniformly magnetized inhomogeneous plasma slab is derived. The spatially varying coefficients of the equation may be written in terms of an arbitrary density profile function provided that the velocity space distribution of the equilibrium is Maxwellian and the plasma is charge neutral. Ion Bernstein waves with frequencies between the first and second ion cyclotron harmonics and wavelengths along the density inhomogeneity larger than the ion Larmor radius are adequately modeled by truncating the differential equation at second order. Using a single mode electrostatic antenna to investigate the role of the diamagnetic drift on Bernstein wave propagation, a wavenumber dependence in the position of the low density cutoff for propagation is found, resulting in a preferential coupling of the antenna to waves with moderate k/sub z/parallel B propagating antiparallel to the ion diamagnetic drift. Moderate levels of Bernstein wave activity inside the plasma are demonstrated for an antenna located in the evanescent region.

47947 **Gyroresonant absorption from congruent reduction of an anisotropic pressure fluid model.** Friedland, L. (Lawrence Berkeley Laboratory, University of California, Berkeley, California 94720). *Physics of Fluids;* **31**: No. 9, 2615-2624(Sep 1988).

A system of Maxwell, multifluid momentum and anisotropic pressure equations for a weakly inhomogeneous magnetized plasma is written in a special Hermitian form. A recently developed congruent reduction technique, for extracting embedded, multidimensional, pairwise mode conversion events, is applied in studying the electron gyroresonant absorption problem. The mode conversion from an electromagnetic mode to a fluid pressure mode near the fundamental and second harmonic gyrofrequency is interpreted as gyroresonant absorption. The transmission coefficient is found in an arbitrary three-dimensional plasma and magnetic field geometry, demonstrating the potential of the approach for systematically reducing the order in general multicomponent wave propagation problems in nonuniform plasmas.

47948 **Access to the second stability region in a high-shear, low-aspect-ratio tokamak.** Gerver, M.J.; Kesner, J.; Ramos, J.J. (Massachusetts Institute of Technology, Cambridge, Massachusetts 02139). *Physics of Fluids;* **31**: No. 9, 2674-2682(Sep 1988).

It is known that tokamaks display a second region of stability to ideal magnetohydrodynamic (MHD) internal modes. An important determining factor for MHD properties is the radial profile of toroidal current. Here it is shown that in a low-aspect-ratio tokamak with high on-axis safety factor ($q_0 \cong 2$) and high shear, a path to high beta can be obtained that remains completely stable against ideal MHD modes. By maintaining high shear this scenario avoids fixed boundary instabilities for both high and low toroidal mode numbers for beta values well above the Troyon limit (stability was tested up to $\epsilon\beta$/sub p/ = 1.4, β = 10.8%). For a close fitting wall (a/sub wall//a/sub plasma/$\cong$1.2) this configuration is also stable to low toroidal mode number balloon-kink modes.

47949 **Plasma rotation during spheromak formation.** Peyser, T.; Goldenbaum, G.C. (Laboratory for Plasma and Fusion Energy Studies, University of Maryland, College Park, Maryland 20742). *Physical Review Letters;* **61**: No. 8, 955-958(22 Aug 1988).

We observe Doppler shifts of a CIII impurity line in a spheromak plasma showing toroidal rotation during the formation phase of the spheromak configuration but not during the equilibrium or decay phase. The evolution of the velocity fields is consistent with the estimated rate of cross helicity decay given the viscosity and resistivity of the plasma.

47950 **Quantum calculations of the electronic structure of a many-atom plasma.** Younger, S.M.; Harrison, A.K.; Fujima, K.; Griswold, D. (Lawrence Livermore National Laboratory, Livermore, California 94550). *Physical Review Letters;* **61**: No. 8, 962-965(22 Aug 1988).

We have performed a set of prototypical quantum calculations of the electronic structure of a none-atom helium plasma over wide ranges of temperature and density. These calculations reveal the presence of very tightly bound quasimolecular states in high-density plasmas, even at temperatures high enough to ionize fully the component atoms. The results of the study suggest that there are four regimes in a plasma, dependent upon the relationship of the electron wavelength to the interionic spacing: low-density atomic, intermediate-density screened atomic, high-density quasimolecular, and very-high-density homogeneous.

47951 **Comments on the linear theory of the gyrotron.** Borie, E.; Jodicke, B. (Dept. of Electrical Engineering, State Univ. of New York, New Paltz, NY (US)). *IEEE (Institute of Electrical and Electronics Engineers) Transactions on Plasma Science;* **16**: No. 2, 116-121(Apr 1988).

Alternative methods for the calculation of the starting current in a gyrotron and the analysis of the excitation of parasitic modes in gyrotrons operating in a given mode are described. Numerical examples are presented which illustrate the importance of using a correct model for the field profile and the influence of numerical uncertainties on the results obtained using a linear theory for mode competition.

47952 **Operating modes of relativistic rising-sun and A6 magnetrons.** Treado, T.A.; Doggett, W.O.; Thomas, G.E.; Smith, R.S. III; Jackson-Ford, J.; Jenkins, D.J. (Physics Dept., North Carolina State Univ., Raleigh, NC (US)). *IEEE (Institute of Electrical and Electronics Engineers) Transactions on Plasma Science;* **16**: No. 2, 237-248(Apr 1988).

The authors investigated the operating characteristics of a relativistic 16-vane rising-sun magnetron with particular emphasis on determining the operating regimes of different modes. They studied the magnetron performance as a function of voltage, magnetic field, cathode geometry, axial boundary conditions, and output coupling. Operation was observed in the $3\pi/8$ mode at 3.3 GHz, in the $\pi/2$ or $3\pi/8$ mode at 3.5 GHz, and in the π or $7\pi/8$ mode at 4.6 GHz. A maximum power of 80 MW was emitted in the $3\pi/8$ mode with an efficiency of 4.5 percent. Typical pulse lengths were 40-50 ns. Cold tests were performed to measure the resonant frequencies and azimuthal electric fields in the interaction space with agreed within 1-4 percent of theoretical calculations. The operating modes were inferred from close agreement (1-3 percent) between hot-test frequencies and cold-test results and the fact that high-power RF emission occurred at, or just above, the Buneman-Hartree threshold calculated for these modes. The authors also studied the characteristics of a six-vane A6 magnetron operating in the π and 2π modes. A unique transmitting-receiving system, which was used as a microwave diagnostic, is described.

47953 **Operational features and microwave characteristics of the Vircator II experiment.** Price, D.; Fittinghoff, O.; Benford, J.; Sze, H.; Woo, W. (Physics International Co., San Leandro, CA (US)). *IEEE (Institute of Electrical and Electronics Engineers) Transactions on Plasma Science;* **16**: No. 2, 177-184(Apr 1988).

The Vircator II oscillating virtual-cathode microwave source operates with diode voltages between 600 and 800 kV and diode current between 50 and 120 kA. Maximal microwave output power between 200 and 500 MW is achieved when the diode aspect ratio, cathode surface, charge voltage, and extraction coupling are arranged to simultaneously 1) maximize diode voltage, 2) satisfy magnetic insulation criteria, 3) avoid nonuniform or unstable electron emission, and 4) optimize microwave transmission from the virtual cathode to the launching antenna. Broad-band radiation between 0.4 and 5.5 GHz is generated. The central frequency follows the beam plasma frequency. It is tuned by varying the current density with anode-cathode (A-K) gap adjustments.

47954 **Theory of high-harmonic gyrotron oscillators with slotted cross-section structure.** Vitello, P.; Menyuk, C. (Science Applications International Corp., McLean, VA (US)). *IEEE (Institute of Electrical and Electronics Engineers) Transactions on Plasma Science;* **16**: No. 2, 105-115(Apr 1988).

A linear-theory analysis of gyrotron oscillators with slotted cross section is used to calculate the net change in beam energy [$\delta\gamma$]/sub tophio/. In the authors new formalism, geometric factors are clearly distinguished from the geometry-independent harmonic resonance terms which are due to the fundamental electron cyclotron maser and peniotron interactions. This separation of the interaction terms from the geometric factors greatly simplifies the physical analysis, and leads to a very compact form for [$\delta\gamma$]/sub tophio/. The theory is applied to slotted rectangular oscillators (which have not previously been treated) and to slotted cylindrical oscillators to show that a unified expression can be obtained for the start oscillation condition. In sample applications of our theory, it is demonstrated that slots lower the start oscillation condition in both cylindrical and rectangular geometries, and can lead to a decrease in this condition as harmonic number is increased in the rectangular geometry. The use of these slotted devices thus appears quite attractive in the millimeter-wave regime. The authors also find that the peniotron interaction, which is easily identified in our formalism, may be very strong in slotted cavities.

47955 **Theoretical study of the folded waveguide.** Chen, G.L.; Owens, T.L.; Whealton, J.H. (Oak Ridge National Lab., Oak Ridge, TN (US)). *IEEE (Institute of Electrical and Electronics Engineers) Transactions on Plasma Science;* **16**: No. 2, 305-311(Apr 1988).

The authors applied a three-dimensional (3-D) algorithm for solving Maxwell's equations to the analysis of folded waveguides used for fusion plasma heating at the ion cyclotron resonance frequency (ICRF). A rigorous analysis of the magnetic field structure in the folded waveguide is presented. The results are compared to experimental measurements. Optimum conditions for the folded waveguide are discussed.

47956 **Survey of parallel mapping schemes of the particle-in-cell method.** Hiromoto, R. (Los Alamos National Lab., NM (USA)). *Transactions of the American Nuclear Society;* **55**: 327-328(1987). (CONF-8711195—).

From American Nuclear Society winter meeting; Los Angeles, CA, USA (15 Nov 1987).

The particle-in-cell (PIC) method, used in the simulation of fluid dynamics and plasma interactions, is composed of two distinct computational phases that are each highly parallel, yet problematic in their integrated mapping to parallel processing systems. On a parallel distributed memory system, the different data structures prescribed by the push (the acceleration of particles) and solver (the solution of Poisson's equation) computational phases may require large amounts of data communications during transition between these phases. The ratio of global to nearest-neighbor data communication is a function of the parallel decomposition, the computational algorithms [e.g., multigrid versus Fast Fourier Transform (FFT)] selected, and the characteristics of the physical simulation under investigation. The PIC codes implemented and described here are plasma simulation programs. Unfortunately, these codes are different in their computational details, making direct comparisons of their performances tenuous. On the other hand, the details of the different mapping schemes should be instructive in understanding the complexities of the PIC algorithm and the tradeoffs that must be considered in their implementations.

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REFER ALSO TO CITATION(S) 46619, 46671, 46873, 47952, 47953

47957 **(ANL/FPP/TM—222) Liquid metal blanket module testing and design for ITER/TIBER II.** Mattas, R.F.; Cha, Y.; Finn, P.A.; Majumdar, S.; Picologlou, B.; Stevens, H.; Turner, L. (Argonne National Lab., IL (USA)). May 1988. Contract W-31109-ENG-38. 76p. NTIS, PC A05/MF A01; 1; GPO Dep. Order Number DE88014688/JAW.

A major goal for ITER is the testing of nuclear components to demonstrate the integrated performance of the most attractive concepts that can lead to a commercial fusion reactor. As part of the ITER/TIBER II study, the test program and design of test models were examined for a number of blanket concepts. The work at Argonne National Laboratory focused on self-cooled liquid metal blankets. A test program for liquid metal blankets was developed based upon the ITER/TIBER II operating schedule and the specific data needs to resolve the key issues for liquid metals. Testing can begin early in reactor operation with liquid metal MHD tests to confirm predictive capability. Combined heat transfer/MHD tests can be performed during initial plasma operation. After acceptable heat transfer performance is verified, tests to determine the integrated high temperature performance in a neutron environment can begin. During the high availability phase operation, long term performance and reliability tests will be performed. It is envisioned that a companion test program will be conducted outside ITER to determine behavior under severe accident conditions and upper performance limits. A detailed design of a liquid metal test module and auxiliary equipment was also developed. The module followed the design of the TPSS blanket. Detailed analysis of the heat transfer and tritium systems were performed, and the overall layout of the systems was determined. In general, the blanket module appears to be capable of addressing most of the testing needs. 8 refs., 27 figs., 11 tabs.

47958 **(ANL/FPP/TM—225) Tritons and tritides as the solute and diffusing species in ceramic tritium breeders.** Fischer, A.K.; Johnson, C.E. (Argonne National Lab., IL (USA). Fusion Power Program). Jun 1988. Contract W-31109-ENG-38. 29p. NTIS, PC A03/MF A01; 1; GPO Dep. Order Number DE88015345/JAW.

Intragranular diffusion of tritium is one component of the overall process for tritium release from lithium-containing ceramics that may be used to breed tritium in a fusion reactor. The nature of this transport is reviewed in terms of the understanding established for the mechanism of hydrogen migration in other oxides. In this mechanism, the diffusing species is the proton, which moves from oxide ion to oxide ion, thereby giving rise to apparent hydroxide migration. Analogously, at high oxygen activity, the tritio, transiently bonded to successive oxides and forming successive tritoxides, is taken to be the dominant migrating species in ceramic breeders. In addition, tritide is a significant participant in tritium release at low oxygen activity. The relationship of tritons and tritides as the migration species to the observed release of both reduced and oxidized forms of tritium can be understood in terms of the thermodynamic conditions that prevail. Mechanisms are proposed to rationalize the participation of these species. 29 refs., 3 figs.

47959 **(CAPE—3007) Nova mirror assemblies: [Engineering materials].** Hughes, D.W. (Lawrence Livermore National Lab., CA (USA)). 1982. Contract W-7405-ENG-48. 135 OSTI, PO Bx 62, Oak Ridge, TN 37831.

The Nova target chamber, located in a room separate from the laser room, is approximately 180 ft. from the output end of each laser beam. Turning mirrors are used to direct the beams the rest of the way to the target; for a 10-beam system, nine of the beams need four mirrors and one uses six mirrors. Construction of the Nova mirror assemblies has begun, and we expect the first deliveries in April 1982.

47960 **(DOE/ER/30024—T2) Heavy ion fusion III.** Hammer, D.; Max, C.; Perkins, F.; Rosenbluth, M. (Mitre Corp., McLean, VA (USA). Jason Program Office). Mar 1987. Contract AI01-82ER30024. 37p. NTIS, PC A03/MF A01; 1; GPO Dep. Order Number DE88013484/JAW.

This report updates Heavy Ion Fusion, JSR-82-302, dated January, 1983. During the last four years, program management and direction has been changed and the overall Inertial Confinement Program has been reviewed. This report therefore concentrates on accelerator physics issues, how the program has addressed those issues during the last four years, and how it will be addressing them in the future. 8 refs., 3 figs.

47961 **(DOE/ER/53198—125) Studies of a poloidal divertor reversed field pinch.** Sarff, J.S.; Almagri, A.F.; Assadi, S.; Den Hartog, D.J.; Dexter, R.N.; Prager, S.C.; Sprott, J.C. (Wisconsin Univ., Madison (USA). Dept. of Physics). Jul 1988. Contract FGG2-85ER53198. 22p. NTIS, PC A03/MF A01; 1; GPO Dep. Order Number DE88015027/JAW.

An attempt has been made to form a reversed field pinch (RFP) in a poloidal divertor configuration which position the plasma far from a conducting wall. In this configuration, the plasma is localized within a magnetic separatrix formed by the combination of toroidal currents in the plasma and four internal aluminum rings. Plasmas were formed with plasma current {approximately}135 kA, toroidal field reversal lasting {approximately}1 msec, line-averaged density {approximately}1–2 {times} 10^{13} cm/sup {minus}3/ and central electron temperature {approximately}55 eV, but a large asymmetry in the magnetic field (δB/B {approximately}40%) onset at about the time the toroidal field reversed at the wall. Symmetric, poloidal divertor RFP equilibria were not formed. This behavior might be expected based on linear MHD stability analysis of a cylindrical plasma bounded by a large vacuum region and distant conducting wall. The symmetric equilibrium before the asymmetry develops and the asymmetry itself are described. 15 refs., 3 figs.

47962 **(ENEA-RT-FUS—87-25) The tilted-winding concept in the design of compact high field toroidal magnets.** (ENEA, Rome (Italy)). Dec 1987. 25p. NTIS (US Sales Only), PC A03/MF A01. Order Number DE88754232/JAW.

A new concept is explored in the design of high field, compact aspect-ratio toroidal magnets for tokamak applications. The proposed new magnet design, which appears to be particularly well suited to cope with both the centripetal and vertical loads on the magnet, is compatible with the fitting of cooling ducts in the volume of the conductor, and directly provides enough of a poloidal flux swing to drive the bulk of the toroidal plasma current required by the tokamak configuration. Results of some preliminary stress and strain calculations are presented.

47963 **(ENEA-RT-FUS—87-26) Contributions to the tenth national congress on vacuum science and technology.** Ferro, C.; Maddaluno, G.; Ciotti, M.; Alessandrini, C.; Apicella, M.L. (ENEA, Rome (Italy)). Feb 1988. 36p. (CONF-8710333—Exc.). NTIS (US Sales Only), PC A03/MF A01. Order Number DE88754241/JAW.

From 10. national congress on vacuum science and technology; Stresa, Italy (12 Oct 1987).

The FTU (Frascati Tokamak Upgrade), at the ENEA-CRE Frascati Research Center, is a compact tokamak with a high magnetic field (8t) and limiter controlled discharges. Its main purpose is to produce high density, high temperature plasmas with long energy confinement time in order to study regimes relevant to reactors. One of the consequences of the operating regime is a high power flux on the walls of the vacuum chamber. This machine and the solutions adopted in the development of the vacuum chamber and the vacuum system are described. The system consists of a metallic, fully welded vessel, pumped by six turbomolecular pumps. It is dimensioned to allow a base pressure lower than 2.6x10/sup-6/ Pa. Cleaning techniques performed on a 1:1 scale toroidal sector are also discussed. In addition, experimental data are reported relevant to a careful analysis of the thermal load to the limiter. The analysis involves the use of a set of thermocouples, embedded within the full poloidal limiter, together with a finite difference heat conduction code, to obtain both the amount and spatial profile of the power lost to the limiter during ohmic discharges.

47964 **(GA-A—19118) CIT divertor conceptual design.** Wesley, J.C.; Sevier, D.L. (General Atomics Co., San Diego, CA (USA)). Jun 1988. Contract AC03-84ER53158. 68p. NTIS, PC A04/MF A01; 1; GPO Dep. Order Number DE88012967/JAW.

A conceptual design of the divertor target assembly for the 1.75-m CIT baseline device has been developed. The divertor target assembly consists of four toroidal arrays of pyrolytic graphite plates that cover the inside surface of the ends of the vacuum vessel in the locations where the magnetic separatrices of the plasma intersect the vessel wall. During the course of the plasma discharge, the currents on the poloidal field coils that establish the plasma equilibrium are varied to sweep the separatrix strike locations across the divertor targets. This spreads the plasma heat loading over sufficient area to keep the peak target surface temperature within allowable limits. The required magnetic sweep ({+-}5 cm for the inside strike location and {+-}12 cm for the outside strike location) can be affected by programming either the external poloidal strike location) can be effected by programming either the external poloidal field (PF) coils or the internal PF control coils plus the external PF solenoid coils (PF1 and PF2). The ensuing variations in the elongation and triangularity of the plasma are modest, and fall within the ranges of plasma elongation and triangularity specified in the CIT General Requirements Document. 17 figs., 13 tabs.

47965 **(INDC(CCP)—282/GFR) Influence of a priori information and choice of activation detectors in integral experiments on the accuracy of neutron spectrum unfolding in fusion reactor blanket models.** (International Atomic Energy Agency, Vienna (Austria). International Nuclear Data Committee). Apr 1988. 34p. NTIS (US Sales Only), PC A03/MF A01. Order Number DE88703863/JAW.

Translated from Russian.

The document contains the following two papers translated from Russian: Choice of activation detectors for integral experiments in the fusion reactor blanket models; Influence of a priori information on the accuracy of "thermonuclear" neutron spectrum unfolding. A separate abstract was prepared for each of these papers. Refs, figs and tabs.

47966 **(IYF-R—5-284) Technique for calculating thermal effect of pulsed plasma flows on materials in simulation experiments.** Gurvich, L.G.; Fedorenko, A.I.; Shaposhnikov, S.A. (AN Uzbekskoj SSR, Tashkent. Inst. Yadernoj Fiziki). 1987. 10p. (In Russian). NTIS (US Sales Only), PC A02/MF A01. Order Number DE88703640/JAW.

The method of calculation approach determination of thermal processes course during materials test on various plasma installations is described. Condition of large number of experiments allows according measured data of mass transfer and to nature of destructions on the surface to make conclusions about correspondence of these results to preliminary calculations (that confirms sufficient reliability of the latter). 5 refs.; 2 figs.

47967 **(IYF-R—6-266) Energy spectra of gold and silver ions jointly expanding in multielement laser plasma.** Bedilov, M.R.; Kuramatov, D.; Tsoj, T.G.; Kholbaev, A.; Khaitbaev, K. (AN Uzbekskoj SSR, Tashkent. Inst. Yadernoj Fiziki). 1986. 12p. (In Russian). NTIS (US Sales Only), PC A03/MF A01. Order Number DE88703642/JAW.

The results of the investigations on energy distribution of Au and Ag ions jointly expanding in multielement paser plasma are presented. It is denonstrated, that on the stages of formation and expanding of multielement plasma multucharged ions considerable contribution is made by collision processes between electrons and ions and between ions of light and heavy elements. The results are discussed on the basis of existing theoretical models. 11 refs.; 4 figs.

47968 **(IYF-R—6-273) Energy and angular distributions of silicon ions in multielement laser plasma.** Bedilov, M.R.; Bajmuradov, M.M.; Khabibullaev, B.K. (AN Uzbekskoj SSR, Tashkent. Inst. Yadernoj Fiziki). 1987. 12p. (In Russian). NTIS (US Sales Only), PC A03/MF A01. Order Number DE88703643/JAW.

Charge and energy characteristics of silicon, which were induced by the λ/sub 1/=1.06 mkm, λ/sub 2/=0.53 mkm laser radiation in the range of q=10/sup 8/-10/sub 11/ W/cm/sup 2/ have been studied using mass spectrometric method. 11 refs.; 6 figs.

47969 **(KMSF-U—1994) The β-heating redistribution of DT [deuterium-tritium] solid fuel in glass shells.** Musinski, D.L.; Mruzek, M.T.; Felmlee, W.J.; Mehler, R.D. (KMS Fusion, Inc., Ann Arbor, MI (USA)). 1988. Contract AC08-87DP10560. 9p. (CONF-8806170—8). NTIS, PC A02. Order Number DE88013017/JAW.

From 6. target fabrication specialist's meeting; Los Alamos, NM, USA (19 Jun 1988).

Recent laboratory observations have confirmed that the energy from β-heating is sufficient to redistribution DT fuel in Inertial Confinement Fusion, ICF, shells when the shell is held within an isothermal container. There are several steps that now must be taken in the development of this technology. We know that the presence of He^3 within the interior of the shell will impede the redistribution of the DT. Therefore, the rates at which a DT fuel layer becomes uniform must be experimentally established. To allow target designers to evaluate various options, we need to experimentally determine the limits on the fuel layers uniformity. In addition, to consider realistic hardware systems that can produce these targets, we need to establish the effects that a non-isothermal environment will have on the fuel layer uniformity. To address some of these questions, KMS Fusion has designed and constructed an experimental system that provides an isothermal environment from the shell, and allows the fuel layer uniformity to be documented. Preliminary experiments using this system demonstrate that there are several options for using β-decay heat to produce a uniform solid fuel layer. These experiments indicate that slowly cooling the shell through the triple points of the DT fuel mixture results in a significant increase in the uniformity of the initial solid layer. 8 refs., 7 figs.

47070 **(LA-UR—88-2388) The Tritium Systems Test Assembly applicability to ITER.** Anderson, J.L. (Los Alamos National Lab., NM (USA)). 1988. Contract W-7405-ENG-36. 6p. (CONF-880890—1). NTIS, PC A02/MF A01; 1; GPO Dep. Order Number DE88014337/JAW.

From ITER tritium workshop; Garching, F.R. Germany (9 Aug 1988).

The Tritium Systems Test Assembly (TSTA), is operated by the Los Alamos National Laboratory (LANL) under the sponsorship of the US Department of Energy (DOE) and the Japan Atomic Energy Research Institute (JAERI). The objectives of the TSTA project are to develop, demonstrate, and evaluate the exhaust gas processing and tritium related safety systems for the magnetic fusion energy program. The applicability of these processes for the ITER Tokamak is discussed.

47071 **(LBL—25401) A refined model for characterizing x-ray multilayers.** Oren, A.L.; Henke, B.L. (Lawrence Berkeley Lab., CA (USA)). Dec 1987. Contract AC03-76SF00098. 61p. NTIS, PC A04/MF A01; 1; GPO Dep. Order Number DE88013592/JAW.

The ability to quickly and accurately characterize arbitrary multilayers is very valuable for not only can we use the characterizations to predict the reflectivity of a multilayer for any soft x-ray wavelength, we also can generalize the results to apply to other multilayers of the same type. In addition, we can use the characterizations as a means of evaluating various sputtering environments and refining sputtering techniques to obtain better multilayers. In this report we have obtained improved characterizations for sample molybdenum-silicon and vanadium-silicon multilayers. However, we only examined five crystals overall, so the conclusions that we could draw about the structure of general multilayers is limited. Research involving many multilayers manufactured under the same sputtering conditions is clearly in order. In order to best understand multilayer structures it may be necessary to further refine our model, e.g., adopting a Gaussian form for the interface regions. With such improvements we can expect even better agreement with experimental values and continued concurrence with other characterization techniques. 18 refs., 30 figs., 7 tabs.

47072 **(ND-R—1434(S)) Review of the behaviour of graphite under the conditions appropriate for protection of the first wall of a fusion reactor.** Birch, M.; Brocklehurst, J.E. (UKAEA Northern Research Labs., Risley). Dec 1987. 113p. NTIS (US Sales Only), PC A06/MF A01. Order Number DE88754291/JAW.

The material used as a first wall protection in fusion reactor systems will be exposed to 14 MeV neutrons from the fusion reaction and suffer surface bombardment by other energetic particles in the plasma. Graphite is a potential candidate for the first wall material. Calculations are performed of the damaging power of 14 MeV neutrons so that existing graphite irradiation data can be utilised. Such data at high irradiation temperatures are reviewed for a wide range of graphite types, characterised by specific examples, and the application of the data to design calculations is discussed. The erosion/corrosion effect of the plasma at the graphite surface is also considered. Limitations in the state of knowledge are identified, and particular areas of further work are recommended.

47073 **(SAND—87-0676) Environmental effects on friction and wear of the ALT-II [Advanced Limiter Test II] limiter blade positioning mechanisms.** Brown, G.W.; Croessmann, C.D.; Watkins, J.G.; Banks, J.C. (Sandia National Labs., Albuquerque, NM (USA)). Jan 1988. Contract AC04-76DP00789. 26p. NTIS, PC A03/MF A01; 1; GPO Dep. Order Number DE88015343/JAW.

Advanced Limiter Test II (ALT-II) is an eight-module pumped limiter system which is being installed in the TEXTOR tokamak at KFA, Juelich, FRG. The modules are supported by 16 drive mechanisms, which provide the capability of remotely adjusting the limiter positions. These mechanisms were designed, fabricated, and tested at Sandia and were shown to operate successfully in a simulated TEXTOR environment. However, it was found that the capability of operating in the high-vacuum, high-temperature environment of tokamak does not assure smooth operation in the seemingly less hostile environment of room-temperature air. Several ways of improving the performance of the mechanisms were identified and implemented. Following the modifications, each mechanism successfully passed a test of limited running in air at room temperature. This investigation also showed that the mechanisms perform much better in vacuum than in air, apparently due to enhanced performance of the MoS_2 lubricant in vacuum. 3 refs., 24 figs.

47074 **(UCID—21453) The use of idle equipment for ITER [International Thermonuclear Engineering Reactor] magnet development.** Miller, J.R. (Lawrence Livermore National Lab., CA (USA)). 11 Jul 1988. Contract W-7405-ENG-48. 15p. NTIS, PC A03/MF A01; 1; GPO Dep. Order Number DE88014189/JAW.

Test facilities that can be effectively applied to International Thermonuclear Engineering Reactor (ITER) magnet needs are scarce because the costs and the time required to produce them from the ground up tend to be prohibitive. It has been proposed as an option that several unique and valuable pieces of equipment that are already owned by the DOE be consolidated into the Lawrence Livermore National High Field Test Facility (HFTF) which may be uniquely qualified to make effective use of them. 6 figs., 4 tabs.

47075 **(UCLA/PPG—1074) Plasma-surface interactions and materials research: Progress report on PISCES.** Conn, R.W.; Goebel, D.M.; Hirooka, Y.; LaBombard, B.; Leung, W.K.; Nygren, R. (California Univ., Los Angeles (USA). Center for Fusion Physics and Engineering). Jul 1987. Contract AS03-84ER52104. 18p. NTIS, PC A03/MF A01; 1; GPO Dep. Order Number DE88014103/JAW.

The PISCES Program continues to provide data on the behavior of materials subject to continuous ion bombardment from a steady state plasma related work includes the development of diagnostics and the investigation of plasma behavior in PISCES through which the conditions in PISCES can be related to edge conditions in tokamaks. Within the context of the technical scope of the national fusion program as described in the Technical Planning Activity, PISCES plays an important role in the resolution of issues relating to erosion and redeposition (Level 3 Logic Diagram for Particle and Impurity Control). This report briefly summarizes the status of the current PISCES experiments and near term plans for research by the PISCES Group in the areas of enhanced pumping of neutral gases by graphite, hydrogen recycling from activated graphite surfaces, erosion of graphite, new diagnositics for in-situ monitoring of erosion yield, pump limiter experiments, spectroscopy and diagnostic development. Experimental equipment includes the existing PISCES facility, AES/SIMS surface analysis facility, PISCES-B, which is now under construction, and experimental probes being developed for use in the Continuous Current Tokamak (CCT). 8 figs.

47976 (UCRL—98094) A turning point in the US Inertial Confinement Fusion Program. Hogan, W.J. (Lawrence Livermore National Lab., CA (USA)). 7 Apr 1988. Contract W-7405-ENG-48. 15p. (CONF-880417—23). NTIS, PC A03/MF A01; 1; GPO Dep. Order Number DE88014152/JAW.

From International symposium on nuclear fusion technology; Tokyo, Japan (10 Apr 1988).

The goal of the US ICF Program is to obtain a high-yield (100 to 1000 MJ) and high-gain (about 100) thermonuclear fusion capability in the laboratory. It has long been recognized that before such a laboratory facility is constructed, it must be demonstrated that laboratory conditions can be created that will, with high probability, lead to high gain if a driver of sufficient energy is built and that such a facility can be built at reasonable cost. Thus, the two major aspects of the US program address target physics and driver development. Four main driver candidates are actively being pursued: solid state lasers (principally Nd:glass), KrF gas lasers, light ion beams (Li ions accelerated by ion diodes), and heavy ion beams)A {approximately}200, accelerated by linear induction accelerator). The target physics aspect of the program is further divided into indirect and direct drive targets. In indirect drive targets the driver beams are aimed at a material near the capsule to generate x-rays, which then are absorbed in the fusion capsule ablator to produce the implosion. In direct-drive targets, the driver beams are aimed at the surface of the capsule. However, even in this case it should be recognized that the beam energy is deposited in the plasma surrounding the capsule, then transported to the ablation surface by electrons. Experimental target physics results recently obtained, principally for indirect-drive targets, have led to high confidence that a suitably-shaped 10 MJ pulse is sufficient to achieve high-gain and yields of 100 to 1000 MJ will result. 7 figs.

47977 Bounce-coated ablation layers on fusion targets. Gram, R.Q.; Immesoete, C.K.; Kim, H.; Forsley, L. (Laboratory for Laser Energetics, University of Rochester, Rochester, New York 14623-1299). *Journal of Vacuum Science and Technology, A: Vacuum, Surfaces, and Films;* **6**: No. 5, 2998-3001(Sep 1988).

The current effort to achieve high compression of deuterium—tritium fuel by the Laboratory for Laser Energetics utilizes targets which are coated with uniform ablation layers of parylene. These layers are applied to the targets while they bounce on the vertically vibrating surface of a resonator. The low-power plasma required to prevent targets from sticking to each other and to the vibrating surface increases the deposition rate by a factor of 2 to 4. Careful control of plasma conditions is required to maintain bouncing while avoiding overly rapid polymerization, defect growth, embrittlement, and other adverse effects in the parylene layers. Ablation layer quality is studied as a function of parylene monomer pressure, argon pressure, and plasma power, and the optimum operating region is discussed. Automatic control of these parameters is described. A tensile strength of 36 MPa is achieved in the bounce-coated parylene layers, adding considerable strength to polymer shell targets. The permeability of these layers to Ar and He is measured.

47978 High-power and superpower Cerenkov masers. De Groot, J.S.; Stone, R.A.; Mizuno, K.; Rogers, J.H.; Pointon, T.D. (Dept. of Applied Science, Univ. of California at Davis, Davis, CA (US)). *IEEE (Institute of Electrical and Electronics Engineers) Transactions on Plasma Science;* **16**: No. 2, 206-216(Apr 1988).

The linear and nonlinear theory of the efficient operation of high-power (gigawatt) and superpower (50 GW) Cerenkov masers is developed and discussed. Important technology issues such as breakdown, plasma production, and coupling to the output device are discussed. The relative merits of dielectric Cerenkov masers (DCM's) and plasma Cerenkov masers (PCM's) are considered. The principal design tool is a new particle simulation model that has been developed to investigate Cerenkov masers. The novel aspects of this model are briefly described along with a comparison of calculated and experimental results. The agreement between calculations and measurements is generally good. Finally, designs for a high-power and superpower PCM are described. These generators are compact and efficient (10- to 20- percent conversion from beam energy to microwave energy).

47979 High-power microwave generation from large-orbit devices. Destler, W.W.; Chojnacki, E.; Hoeberling, R.F.; Lawson, W.; Singh, A.; Striffler, C.D. (Electrical Engineering Dept. and the Lab. of Plasma and Fusion Energy Studies, Univ. of Maryland, College Park, MD (US)). *IEEE (Institute of Electrical and Electronics Engineers) Transactions on Plasma Science;* **16**: No. 2, 71-89(Apr 1988).

Experimental and theoretical studies at the University of Maryland on the production of high-power microwave radiation in cusp-injected, large-orbit devices are reviewed. Three classes of devices belonging to this category are discussed. In the first case, an axis-encircling rotating electron beam interacts via the negative mass instability with the modes of a smooth cylindrical waveguide, producing broad-band radiation at multiple harmonics of the electron cyclotron frequency. In the second case, the beam interacts with a multiresonator magnetron circuit designed to provide mode control, resulting in high-power radiation at a desired cyclotron harmonic. In the third case, the beam interacts with a transverse wiggler magnetic field produced by samarium-cobalt magnets placed interior and/or exterior to the beam. In this case the interaction is analogous to a circular geometry free-electron laser. The most recent experimental results from all three configurations are reviewed and compared with theoretical expectations. The possibility of enhanced operational efficiency in all of these devices by electron energy recovery is discussed, and a design for a first experiment to test this concept is presented.

47980 Direct experimental observation of π-mode oscillation in a relativistic magnetron. Smith, R.R.; Sze, H.; Harteneck, B.; Benford, J. (Physics International Co., San Leandro, CA (US)). *IEEE (Institute of Electrical and Electronics Engineers) Transactions on Plasma Science;* **16**: No. 2, 234-236(Apr 1988).

The authors report the direct measurement of the operating mode of a relativistic magnetron. They measured the difference between the S-band device by using a commercial phase discriminator bridge. The measured angle was nearly 180°, confirming operation in the "π" mode without relying on comparisons of the operating parameters with theory.

47981 One-dimensional modeling of transport in small stellarators. Mertens, K.J.S.; Hitchon, W.N.G.; Anderson, D.T.; Shohet, J.L. (Torsatron/Stellarator Lab., Univ. of Wisconsin-Madison, Madison, WI (US)). *IEEE (Institute of Electrical and Electronics Engineers) Transactions on Plasma Science;* **16**: No. 2, 296-304(Apr 1988).

An existing stellarator reactor transport code has been modified in order to model small stellarator experiments. Changes have been made in the treatment of the neutrals, the atomic physics processes, and the transport models. The authors investigated the extent to which the hollow density profiles experimentally detected during electron cyclotron resonance heating (ECRH) experiments in the interchangeable module stellarator (IMS), a small modular stellarator, can be modeled. In this, the authors were guided by the experimental observation of large variations in potential around the magnetic surfaces, which can give rise to radially directed E x B convective flow. A diffusion model based on small-scale convective cell structures cannot simulate the experimental profiles. Including a purely convective term in the particle balance equation allows for a much more accurate modeling of the profiles. A comparison between numerical and experimental results is presented.

47982 Effect of helium on irradiation creep in an austenitic stainless steel. Grossbeck, M.L.; Horak, J.A. (Oak Ridge National Lab., TN (USA)). *Transactions of the American Nuclear Society;* **55**: 299-300(1987). (CONF-8711195—).

From American Nuclear Society winter meeting; Los Angeles, CA, USA (15 Nov 1987).

The first wall of a fusion reactor will be subjected to a flux of high-energy neutrons that will result in the formation of atomic displacements and their associated phenomena, coupled with the formation of helium via (n, α) reactions. The purpose of the experiments described here is to determine the irradiation creep properties of several austenitic stainless steels under irradiation conditions that simulate fusion reactor conditions in terms of both damage rate

and helium generation rate (He:dpa ratio). Irradiation creep can be beneficial in a fusion reactor because it relieves swelling and thermal stresses but harmful because it produces deformation in response to primary stresses at temperatures far below the thermal-creep regime. Therefore, it must be accounted for in the design of a fusion reactor.

99 GENERAL AND MISCELLANEOUS

47983 **(DOE/MA—0322-2) Listing of awardee names active awards as of July 5, 1988.** (USDOE Assistant Secretary for Management and Administration, Washington, DC. Office of Review and Analysis). 1988. 507p. NTIS, PC A22/MF A01; 1; GPO Dep. Order Number DE88013078/JAW.

This is a computerized listing issued quarterly from the Procurement and Assistance Data System (PADS), including an alphabetical listing of all acquisition and financial assistance awards (excluding purchase orders) with the Department of Energy. Inactive is defined as the completion date of the award is earlier (in the past) than the date of the issuance of the listing.

47984 **(DOE/MA—0323-2) Listing of awardee names: Inactive awards as of July 5, 1988.** (USDOE Assistant Secretary for Management and Administration, Washington, DC. Office of Review and Analysis). 5 Jul 1988. 403p. NTIS, PC A18/MF A01; 1; GPO Dep. Order Number DE88013181/JAW.

This is a computerized listed issued quarterly from the Procurement and Assistance Data System (PADS), including an alphabetical listing of all acquisition and financial assistance awards (excluding purchase orders) with the Department of Energy. Inactive is defined as the completion date of the award is earlier (in the past) than the date of the issuance of the listing.

47985 **(SAND—88-1336C) A task and technical support sensitive Security Operations Center.** Newell, R.A.; Sena, P.A.; Salazar, J.S. (Sandia National Labs., Albuquerque, NM (USA)). 1988. Contract AC04-76DP00789. 6p. (CONF-880631—17). NTIS, PC A02/MF A01; 1; GPO Dep. Order Number DE88012463/JAW.

From 29. annual meeting of the Institute of Nuclear Materials Management; Las Vegas, NV, USA (26 Jun 1988).

Modern security control and display systems for protected facilities have improved the effectiveness of Security Operations Center (SOC) personnel. The most effective of these utilize sophisticated computerized systems to primarily provide quick and accurate control and display of alarm associated and routine access funcitions. Protected facilities with limited fiscal resources require some type of security control and display system but often cannot justify the cost of equipment and technical support associated with sophisticated systems. This paper describes a disign approach, consisting of four independent building blocks, that provides functionality and complexity commensurate with facility-specific requirements and technical support capabilities. The versatility of the design is demonstrated by showing how the less complex blocks satsify the needs of fiscally limited facilities or the blocks can be intergrated to satisfy the needs of the largest security installations. also, the independent blocks can be intergrated into existing installations to provide needed additional functionality with minimal impact on operations and exisiting equipment. 7 figs.

9901 Management

REFER ALSO TO CITATION(S) 46641

47986 **(DOE/IG—0256) Audit of selected aspects of the management of the Engineering Prototype Group, Rocky Flats Plant, Golden, Colorado.** (USDOE Office of Inspector General, Albuquerque, NM. Western Regional Office). 8 Jul 1988. 11p. H; 1; GPO Dep. Order Number DE88013947/JAW.

This report details findings and recommendations relating to certain activities in the Engineering Prototype Group at the Rockwell Rocky Flats Plant (Rockwell). The purpose of the audit was to determine if administrative internal controls had been established to deter a recurrence of reported unauthorized activities; to evaluate Rockwell's current policy for making medallions and using precious metals; and to identify the cost incurred on reported improprieties, and the extent to which those costs are recoverable.

9902 Mathematics And Computers

REFER ALSO TO CITATION(S) 46243, 46873

47987 **(AD-A—192695/5/XAB) Parallelism and the Penman natural-language-generation system. Research report.** Tung, Y.W.; Matthiessen, C.; Sondheimer, N. (University of Southern California, Marina Del Rey (USA). Information Sciences Inst.). Apr 1988. 44p. (ISI/RR—88-195). NTIS, PC A03/MF A01.

This report discusses parallel processing for the Penman natural-language-generation system. The authors first analyze the computational requirement of the generation process. They then identify aspects of this computation that could benefit from being carried out in parallel. The Penman generator is composed of a systemic grammar, the Nigel grammar, and its environment. These two components are functionally separated and interface to each other via an inquiry mechanism. This implies that Nigel and its environment can be processed in a distributed way. We also illustrate how both Nigel and the major part of its environment, the KL-TWO knowledge base, can each be processed in parallel. In the Nigel grammar, the systems, choosers and realization statements can be activated simultaneously according to some computational dependency that resembles the system network. The KL-TWO knowledge base can be implemented as a parallel computing system, and two existing approaches, using Classifier Systems and Connectionist Models, respectively, are analyzed and assessed.

47988 **(CERN—88-03) 1987 CERN School of Computing: Proceedings.** Verkerk, C. (ed.). (European Organization for Nuclear Research, Geneva (Switzerland)). 8 Jun 1988. 428p. (CONF-8709308—). CERN, European Organization for Nuclear Research, CH-1211, Geneva, Switzerland. Order Number TI88013866/JAW.

From CERN school of computing; Troia, Portugal (13 Sep 1987).

These Proceedings contain written versions of most of the lectures delivered at the 1987 CERN School of Computing. Five lecture series treated various aspects of data communications: integrated services networks, standard LANs and optical LANs, open systems networking in practices, and distributed operating systems. Present and future computer architectures were covered and an introduction to vector processing was given, followed by lectures on vectorization of pattern recognition and Monte Carlo code. Aspects of computing in high-energy physics were treated in lectures on data acquisition and analysis at LEP, on data-base systems in high-energy physics experiments, and on Fastbus. The experience gained with personal work stations was also presented. Various other topics were covered: the use of computers in number theory and in astronomy, fractals, and computer security and access control.

47989 **(DOE/ER—0368) Federal Coordinating Council on Science, Engineering and Technology, Committee on Computer Research and Applications, Subcommittee on Science and Engineering Computing: Annual report, 1987.** (Office of Science and Technology Policy, Washington, DC (USA)). Mar 1988. 13p. NTIS, PC A03/MF A01; 1; GPO Dep. Order Number DE88013228/JAW.

In the past year the committee initiated efforts that resulted in the report "A Research and Development Strategy for High Performance Computing" and will presently provide a government-wide implementation plan to address the technological opportunities possible with the achievement of significantly enhanced supercomputer capability. The committee met on a regular basis to review government supported programs in research, development and application of new supercomputer technology. The Committee annually visits supercomputer manufacturers to be briefed on their plans for future generation machines. Cray Research and ETA Systems continue to make progress toward developing more advanced

supercomputers. The US supercomputer manufacturers remain dependent upon their emerging Japanese competitors for high performance IC'S although progress has been made toward achieving more adequate domestic sourcing. Reports by the Defense Science Board and the National Security Council/Economic Policy Council, which addressed semiconductor issues, were completed during the year with advice and input from the Committee. IBM has reentered the supercomputer marketplace. The current 3090 series with expandable vector processing capability has achieved a low end position in the supercomputer performance spectrum. Subsequent development and marketing by IBM of more powerful machines would have important and far reaching impact on the domestic and world supercomputer market. Computers with massively parallel architecture--thousands of processors--are entering the market place and are beginning to become more of a factor in the computational productivity scale.

47990 **(DPST—86-513) Ad-hoc computer coding standards committee.** White, A.M. (Savannah River Lab., Aiken, SC (USA)). 29 Jul 1986. Contract AC09-76SR00001. 7p. NTIS, PC A02/MF A01; 1; GPO Dep. Order Number DE88014494/JAW.

An ad-hoc computer programming standards committee was formed on May 6, 1986. The mission of the committee is to produce a programming standards manual and a method for implementing the standards with input from NED, SCD, and RSRD personnel and American National Standards Institute (ANSI) standards so that the following benefits will be reaped: enhancement of code legibility, easier code maintenance, easier upgrade of codes, compliance with recognized standards, and easier code proramming. The committee is very interested in obtaining feedback from the personnel in the various divisions concerning the standards which we are proposing. For this reason we are ataching a copy of what we consider to be good coding proctices; practices which we feel should be followed in all codes produced by NRTSC. We are also attaching a copy of what we consider an "ideal" subroutine.

47991 **(ITEF—169(1987)) Software of a physical experiment on-line system on the ES-1011 computer base.** Bobchenko, B.M.; Gushchin, O.B.; Danilova, R.A. (Gosudarstvennyj Komitet po Ispol'zovaniyu Atomnoj Ehnergii SSSR, Moscow. Inst. Teoreticheskoj i Ehksperimental'noj Fiziki). 1987. 16p. (In Russian). NTIS (US Sales Only), PC A03/MF A01. Order Number DE88703604/JAW.

Software designed for creation of EC-1011 computer-base system for collection, processing and accumulation of data, coming from physical devices, their electronic equipment being produced according to CAMAC-VECTOR standard, is described. It takes about 0.5 ms to start up or process the end of exchange channel operation by direct access to the storage, and the rate of exchange by direct access channel makes up about 250 kword/s. With accelerator operation period making up 2.5 s and dropping duration making up 1 s the system allows one to take up to 70 kbyte as dropping with system buffer capacity being 64 kbyte. 8 refs.; 1 fig.

47992 **(JINR—9-87-768) Interactive program for calculating charged particle beam transport channels on SM-4 computer.** Vasilishin, B.V.; Volkov, V.I.; Kulikov, I.I. (Joint Inst. for Nuclear Research, Dubna (USSR). Lab. of High Energy). 1987. 8p. (In Russian). NTIS (US Sales Only), PC A02/MF A01. Order Number DE88703654/JAW.

Interactive program for calculating charged particle beam transport channels is described. The program has been created on SM-4 computer of High Energies Laboratory accelerator center. As program input data the channel element parameters and beam characteristics in the initial point are given. The program permits to calculate the beam envelopes, orbit position, α-, β-, γ-functions, dispersion and its derivative etc. The optimization mode has been realised by the gradient method. The calculation results can be represented in the graphic form on a colour TV monitor or a plotter and in the alpha-numerical form on a terminal screen or a printer. 4 refs.; 2 figs.

47993 **(JINR—E-5-87-698) Estimation of parameters and the goodness-of-fit test for multivariate distributions for data presented as one-dimensional histograms.** Chernov, N.I.; Ososkov, G.A.; Kurbatov, V.S. (Joint Inst. for Nuclear Research, Dubna (USSR). Lab. of Computing Techniques and Automation). 1987. 13p. NTIS (US Sales Only), PC A03/MF A01. Order Number DE88703697/JAW.

The problem of estimating parameters of multiwire probability distributions and testing hypothesis in the framework of physical experiments where data are presented as one-dimensional histograms for every single variable separately are studied. A commonly used method of some of chi/sup 2/-statistics over all single variables is investigated. It is shown that this method is incorrect for dependent variables. A correct generalization of this method is proposed for which analogues of classical theorems concerning asymptotic distributions of chi/sup 2/-statistics are proved for testing hypothesis and estimating parameters. The proposed method is implemented as a FORTRAN-4 program and illustrated by a numerical example for some model of pion-nucleon interactions. 3 refs.; 1 tab.

47994 **(JINR—R-10-87-717) Intelligent terminal for PDP-11/70 computer.** Gyunter, Z.; Elizarov, O.I.; Rezaev, V.E.; Shul'tts, K.Kh. (Joint Inst. for Nuclear Research, Dubna (USSR). Lab. of Neutron Physics). 1987. 5p. (In Russian). NTIS (US Sales Only), PC A02/MF A01. Order Number DE88703769/JAW.

Intelligent terminal (IT) for PDP-11/70 computer based on crate-controller with U880/DDR/ microprocessor, color TV used as a graphic device and network adapter to local area network (LAN) SONET-2 of the Laboratory of Neutron Physics is described. In anomalous mode the IT is used for execusion of some spectra display functions or for debugging programs for crate-controllers. In LAN connection mode the intelligent terminal is used like a PDP-11/70 terminal, and it is also intended for transmission of spectra and programs between IT and the host computer. Using IT improves the efficiency of spectrum data processing, releasing host computer from routine spectra display operations. Being station of SONET-2, the IT has a permanent access to PDP-11/70 host computer resources. 6 refs.; 3 figs.

47995 **(KFTI—87-24) DIMOD program complex for dynamic simulation of defects in metals and alloys.** Gann, V.V.; Marchenko, I.G. (AN Ukrainskoj SSR, Kharkov. Fiziko-Tekhnicheskij Inst.). 1987. 10p. (In Russian). NTIS (US Sales Only), PC A02/MF A01. Order Number DE88703787/JAW.

Computational program complex for dynamic simulation of defects in metals and alloys is described. The program complex may be used for solution of a wide range of problems in solid physics: study of point, linear and plane defect properties, calculation of nonequilibrium phonon states in a crystal, simulation of radiation-induced defects. All programs are highly flexible and fast-acting. Examples of applying the program complex for solving concrete problems in physics of radiation damages are presented. 10 refs.; 6 figs.

47996 **(LA-UR—88-1849) HIERtalker: A default hierarchy of high order neural networks that learns to read English aloud.** An, Z.G.; Mniszewski, S.M.; Lee, Y.C.; Papcun, G.; Doolen, G.D. (Los Alamos National Lab., NM (USA)). 1988. Contract W-7405-ENG-36. 9p. (CONF-880745—5). NTIS, PC A02/MF A01; 1; GPO Dep. Order Number DE88014455/JAW.

From IEEE annual international conference on neural networks; San Diego, CA, USA (24 Jul 1988).

A new learning algorithm based on a default hierarchy of high order neural networks has been developed that is able to generalize as well as handle exceptions. It learns the "building blocks" or clusters of symbols in a stream that appear repeatedly and convey certain messages. The default hierarchy prevents a combinatoric explosion of rules. A simulator of such a hierarchy, HIERtalker, has been applied to the conversion of English words to phonemes. Achieved accuracy is 99% for trained words and ranges from 76% to 96% for sets of new words. 8 refs., 4 figs., 1 tab.

47997 (LA-UR—88-2462) **Simulation-assisted inductive learning.** Buchanan, B.G.; Sullivan, J.; Cheng, Tze-Pin; Clearwater, S.H. (Los Alamos National Lab., NM (USA)). 1988. Contract W-7405-ENG-36. 8p. (CONF-880835—2). NTIS, PC A02/MF A01; 1; GPO Dep. Order Number DE88014398/JAW.

From 7. national conference on artificial intelligence; St. Paul, MN, USA (22 Aug 1988).

Learning by induction can require a large number of training examples. We show the power of using a simulator to generate training data and test data in learning rules for an expert system. The induction program is RL, a simplified version of Meta-DENDRAL. The expert system is ABLE, a rule-based system that identifies and located errors in particle beam lines used in high energy physics. A simulator of beam lines allowed forming and testing rules on sufficient numbers of cases that ABLE's performance is demonstrably accurate and precise. 13 refs., 2 figs.

47998 (LA-UR—88-2512) **Invariant imbedding in two dimensions.** Faber, V.; Seth, D.L.; Wing, G.M. (Los Alamos National Lab., NM (USA)). 1988. Contract W-7405-ENG-36. 23p. (CONF-880123—4). NTIS, PC A03/MF A01; 1; GPO Dep. Order Number DE88014405/JAW.

From Conference on transport theory, invariant imbedding and integral equations; Santa Fe, NM, USA (20 Jan 1988).

J. Corones has noted that the doubling and addition formulas of invariant imbedding can be extended conceptually to very general situations. All that is needed is a black box "process" with n "ports." The {ital i}th port has vector input I/sub i/ and vector output J/sub i/. Addition formulas result when two or more of these processes are joined together to form a new process in some regular way. For example, four congruent squares can be juxtaposed to form a larger square. At each join, the output of one process becomes the input of the other and vice versa. (We always suppose the join to occur at one or more ports.) Addition formulas result from the combination of these shared quantities. Corones has thus pointed out that invariant imbedding is not, as is sometimes asserted, an inherently one-dimensional (1-D) method, but works conceptually in any number of dimensions; some previous work that is conceptually along these lines, with references to other such works, can be found in Refs. 2-4. The details can, of course, become very complicated. We shall show that the method is computationally feasible for certain two-dimensional (2-D) problems. To conform to the thrust of these proceedings, we shall usually phrase our discussions in terms of transport theory rather than speaking of more abstract processes. 7 refs., 13 figs.

47999 (N—88-22602) **Direct-execution parallel architecture for the Advanced Continuous Simulation Language (ACSL).** Carroll, C.C.; Owen, J.E. (Alabama Univ., University (USA)). May 1988. 137p. (NASA-CR—182809; NAS—1.26:182809; BER—424-17). NTIS, PC A07/MF A01.

A direct-execution parallel architecture for the Advanced Continuous Simulation Language (ACSL) is presented which overcomes the traditional disadvantages of simulations executed on a digital computer. The incorporation of parallel processing allows the mapping of simulations into a digital computer to be done in the same inherently parallel manner as they are currently mapped onto an analog computer. The direct-execution format maximizes the efficiency of the executed code since the need for a high level language compiler is eliminated. Resolution is greatly increased over that which is available with an analog computer without the sacrifice in execution speed normally expected with digitial computer simulations. Although this report covers all aspects of the new architecture, key emphasis is placed on the processing element configuration and the microprogramming of the ACLS constructs. The execution times for all ACLS constructs are computed using a model of a processing element based on the AMD 29000 CPU and the AMD 29027 FPU. The increase in execution speed provided by parallel processing is exemplified by comparing the derived execution times of two ACSL programs with the execution times for the same programs executed on a similar sequential architecture.

48000 (N—88-23226, pp vp) **Parallel computer methods for eigenvalue extraction.** Akl, F. (Ohio Univ., Athens (USA)). May 1988. NTIS, PC A20/MF A01. (NASA-CP—3003-VOL-1; E—3970-VOL-1; NAS—1.55:3003-VOL-1; CONF-8805178—).

From Lewis structures technology symposium; Cleveland, OH, USA (24 May 1988).

A new numerical algorithm for the solution of large-order eigenproblems typically encountered in linear elastic finite element systems is presented. The architecture of parallel processing is used in the algorithm to achieve increased speed and efficiency of calculations. The algorithm is based on the frontal technique for the solution of linear simultaneous equations and the modified subspace eigenanalysis method for the solution of the eigenproblem. The advantages of this new algorithm in parallel computer architecture are discussed.

48001 (N—88-23226, pp vp) **Adapting high-level language programs for parallel processing using data flow.** Standley, H.M. May 1988. NTIS, PC A20/MF A01. (NASA-CP—3003-VOL-1; E—3970-VOL-1; NAS—1.55:3003-VOL-1; CONF-8805178—).

From Lewis structures technology symposium; Cleveland, OH, USA (24 May 1988).

EASY-FLOW, a very high-level data flow language, is introduced for the purpose of adapting programs written in a conventional high-level language to a parallel environment. The level of parallelism provided is of the large-grained variety in which parallel activities take place between subprograms or processes. A program written in EASY-FLOW is a set of subprogram calls as units, structured by iteration, branching, and distribution constructs. A data flow graph may be deduced from an EASY-FLOW program.

48002 (N—88-23226, pp vp) **Iterative finite element solver on transputer networks.** Danial, A.; Watson, J. May 1988. NTIS, PC A20/MF A01. (NASA-CP—3003-VOL-1; E—3970-VOL-1; NAS—1.55:3003-VOL-1; CONF-8805178—).

From Lewis structures technology symposium; Cleveland, OH, USA (24 May 1988).

The parallelism inherent in the Conjugate Gradient method is described. The initial results of a parallel implementation on a network of twelve transputers are discussed. The high efficiencies obtained indicate that significant speedup can be obtained with larger transputer arrays if communication overhead can be kept low. To this end, a method of communication that allows large, dynamically reconfigurable transputer arrays to exchange data in log sub 4 N steps for N processors is suggested.

48003 (N—88-23226, pp vp) **Multiprocessor graphics computation and display using transputers.** Ellis, G.K. May 1988. NTIS, PC A20/MF A01. (NASA-CP—3003-VOL-1; E—3970-VOL-1; NAS—1.55:3003-VOL-1; CONF-8805178—).

From Lewis structures technology symposium; Cleveland, OH, USA (24 May 1988).

A package of two-dimensional graphics routines was developed to run on a transputer-based parallel processing system. These routines were designed to enable applications programmers to easily generate and display results from the transputer network in a graphic format. The graphics procedures were designed for the lowest possible network communication overhead for increased performance. The routines were designed for ease of use and to present an intuitive approach to generating graphics on the transputer parallel processing system.

48004 (N—88-23226, pp vp) **Parafrase restructuring of FORTRAN code for parallel processing.** Wadhwa, A. (Sverdrup Technology, Inc., Cleveland, OH (USA)). May 1988. NTIS, PC A20/MF A01. (NASA-CP—3003-VOL-1; E—3970-VOL-1; NAS—1.55:3003-VOL-1; CONF-8805178—).

From Lewis structures technology symposium; Cleveland, OH, USA (24 May 1988).

Parafrase transforms a FORTRAN code, subroutine by subroutine, into a parallel code for a vector and/or shared-memory multiprocessor system. Parafrase is not a compiler; it transforms a

code and provides information for a vector or concurrent process. Parafrase uses a data dependency to reveal parallelism among instructions. The data dependency test distinguishes between recurrences and statements that can be directly vectorized or parallelized. A number of transformations are required to build a data dependency graph.

48005 **(N—88-23427) PROMISE simulation system: software for the simulation of parallel processes.** Dekker, G.J.; Depagter, P.J.; Dejong, T. (Nationaal Lucht- en Ruimtevaartlaboratorium, Amsterdam (Netherlands)). Dec 1986. 21p. (In several languages). (NLR-MP—86077-U; B—8731728; ETN—88-92226; CONF-8703281—). NTIS, PC A03/MF A01.

From CAPE Nederland '87; Amsterdam, Netherlands (17 Mar 1987).

The PROMISE simulation tool to study parallel processes that exchange discrete signals is described. Communication between processes is handled via time-tagged messages. The simulated process is modeled by models and submodels that exchange information in so-called connectors. The simulation model has a tree structure of which the elementary models are freely programmable in FORTRAN. Any (sub) model that obey the same I/O definition can be freely exchanged. The PROMISE software is portable to CYBER, IBM, and VAX mainframes due to the strict adherence of ANSI FORTRAN 77. The package is available on CYBER 180 and IBM 4381 computers. The modular design of PROMISE means that models and submodels of the simulated system can be easily exchanged by other models, for instance more detailed ones. This enables quick parameter studies and detailed studies of certain design aspects of the simulated system. Simulation studies executed using PROMISE, including studies of NAVSAT and liquid sloshing, are outlined.

48006 **(NUREG/CR—4639-Vol.4) Nuclear Computerized Library for Assessing Reactor Reliability (NUCLARR): Part 1, Overview of NUCLARR data retrieval: User's guide.** Gilmore, W.E.; Gentillon, C.D.; Gertman, D.I.; Beers, G.H.; Galyean, W.J.; Gilbert, B.G. (Nuclear Regulatory Commission, Washington, DC (USA). Div. of Reactor and Plant Systems; EG and G Idaho, Inc., Idaho Falls (USA)). Jun 1988. Contract AC07-76ID01570. 30p. (EGG—2458-Vol.4). NTIS, PC A03/MF A01 - GPO. Order Number TI88013646/JAW.

The Nuclear Computerized Library for Assessing Reactor Reliability (NUCLARR) is an automated data base management system for processing and storing human error probability and hardware component failure data. The NUCLARR system software resides on an IBM (or compatible) personal micro-computer. NUCLARR can be used by the end user to furnish data inputs for both human and hardware reliability analysis in support of a variety of risk assessment activities. The NUCLARR system is documented in a five-volume series of reports. Volume IV of this series is the User's Guide for operating the NUCLARR software and is presented in three parts. This document, Part 1: Overview of NUCLARR Data Retrieval provides an introductory overview to the system's capabilities and procedures for data retrieval. The methods and criteria for selection of data sources and entering them into the NUCLARR system are also described in this document.

48007 **(ORNL/TM—10525) Informataion storage alternatives: An overview of laser-based optical technologies.** Gray, N.L.; Mullins, M.C. (Oak Ridge National Lab., TN (USA)). Jun 1988. Contract AC05-84OR21400. 42p. NTIS, PC A03/MF A01; 1; GPO Dep. Order Number DE88013499/JAW.

This report provides a general introduction to laser-based optical data storage for microcomputer-based systems and assesses the current state of the industry. Read Only Memory (ROM) and Write Once, Read Many (WORM) technologies are investigated. The standardization issues facing the industry today are also discussed. Storage and retrieval techniques are presented, with observations regarding their use with massive amounts of data. The outlook for the optical disk market is addressed, and future products and applications are reviewed. Impacts of optical storage on various areas of traditional data storage industries{emdash}magnetic, on-line utilities, microfilm, and publishing{emdash} are examined. 96 refs., 10 figs.

48008 **(RNIIRP—87-1) Comparison of minimization algorithms in realization of least module method.** Volkov, N.G.; Kondrashev, V.S.; Moroz, Z.D. (Rizhskij Nauchno-Issledovatel'skij Inst. Radioizotopnogo Priborostroeniya (USSR)). 1987. 12p. (In Russian). NTIS (US Sales Only), PC A03/MF A01. Order Number DE88703803/JAW.

Application of anti-noise least module method (LMM) for roentgenofluorescence spectrum processing is investigated. Comparison of two minimization algorithms is conducted: Gauss and davidson-Fletcher-Powell methods. Comparison was performed using ES-1045 computer with experimental spectra being processed. Comparison of efficiency for the least-square method and LMM when processing spectra with different peak/background ratio is conducted. 4 refs.; 4 figs.; 5 tabs.

48009 **(SAND—88-1662C) Improving software quality through hierarchical design.** Sardalos, S.L. (Sandia National Labs., Albuquerque, NM (USA)). 1988. Contract AC04-76DP00789. 10p. (CONF-880894—). NTIS, PC A02/MF A01; 1; GPO Dep. Order Number DE88014919/JAW.

From Structured development forum X; San Francisco, CA, USA (8 Aug 1988).

This paper discusses hierarchical software design through its application to an example software product. Decomposition of the software product into discrete functional software sub-products is addressed. Potential improvements in managing and performing software quality assurance activities, such as review, inspection and test, are presented. Resulting simplification of software configuration management, product definition, and reusability is discussed. Finally, the hierarchical approach to software design and production is extended to describe a possible software design environment of the future. 3 refs., 4 figs., 3 tabs.

48010 **(UCRL—21066) Three-dimensional adaptive grid code development: Final report.** Fritts, M. (Lawrence Livermore National Lab., CA (USA); Science Applications International Corp., Annapolis, MD (USA)). Feb 1988. Contract W-7405-ENG-48. 26p. (SAIC—88/1563). NTIS, PC A03/MF A01; 1; GPO Dep. Order Number DE88013805/JAW.

Three-dimensional calculations provide physical insight totally beyond the capabilities of two-dimensional calculations because of the additional physics being modelled. For example, vortex stretching terms can be included in three dimensions, and simulations need not be restricted to symmetric configurations. However, the use of these codes in a deign environment implies increased complexity in hardware, software, and support systems. This report summarizes a collaborative effort involving SAIC, LLNL, and LANL personnel to identify the necessary techniques for a three-dimensional adaptive Lagrangian code for A division calculations, the hardware and soft ware best suited to the effective use of that code in a design environment and the policy decisions that must be made in parallel with code development. The report recommends the development of a code based on mixed tetrahedral and hexahedral zones which continues the thrust of differencing and grid restructuring schemes now in use within A Division for two-dimensional codes. Important extensions are made for the inclusion of nested zones, additional data structures to govern dynamic rezoning algorithms based on local, nested and regional grid entities and a redundancy in data structures to achieve high computational and graphics efficiency. This code structure leads to specific recommendations about the grid restructuring and grid initialization procedure as well as new algorithms to ensure code accuracy for arbitrary aspect ratio zones.

48011 **(UCRL—98841) CFTP: An interprocedural cross reference tool.** Welcome, T. (Lawrence Livermore National Lab., CA (USA)). 31 May 1988. Contract W-7405-ENG-48. 4p. (CONF-8804136—2). NTIS, PC A02/MF A01; 1; GPO Dep. Order Number DE88013808/JAW.

From Cray Users Group meeting; Minneapolis, MN, USA (26 Apr 1988).

This paper will describe a new tool which is being developed jointly with Stevens Institute of Technology to statically analyze a CFT source program. It allows a user to inquire about aliases, definitions, uses, etc. of variables across subroutine boundaries. This tool should aid in identifying regions of code that are eligible for multiprocessing.

48012 **Benchmarks as measures of performance: the Los Alamos approach.** Wasserman, H.J. (Los Alamos National Lab., NM (USA)). *Transactions of the American Nuclear Society;* 55: 316-317(1987). (CONF-8711195—).

From American Nuclear Society winter meeting; Los Angeles, CA, USA (15 Nov 1987).

The computer research and applications group of the Los Alamos National Laboratory (LANL) has been involved in the evaluation of computing performance for many years. The benchmarking effort consists of annual tests on computing systems currently in use at LANL as well as evaluation of new computers that are not in LANL's central computing facility. Attention has been focused primarily on supercomputers, although, for various reasons, less powerful systems are sometimes considered. Supercomputer-benchmarking is a nontrivial task. The benchmark methodology employed at LANL involves several ground rules: (1) currently, LANL only performs uniprocessor tests, even on multiprocessor machines; (2) in the past LANL has not measured input/output (I/O) performance; however, I/O benchmarks are being developed; (3) these benchmark codes consist entirely of Fortran. The codes are computationally intensive, with generally little dependence on operating systems; (4) a benchmark always consists of determining performance at three levels of code tuning: (a) only changes necessary to get the codes running; (b) codes optimized for a new machine with a reasonable investment of programming time; (c) optimal performance.

48013 **Present status of vectorized Monte Carlo.** Brown, F.B. *Transactions of the American Nuclear Society;* 55: 323-324(1987). (CONF-8711195—).

From American Nuclear Society winter meeting; Los Angeles, CA, USA (15 Nov 1987).

Monte Carlo applications have traditionally been limited by the large amounts of computer time required to produce acceptably small statistical uncertainties, so the immediate benefit of vectorization is an increase in either the number of jobs completed or the number of particles processed per job, typically by one order of magnitude or more. This results directly in improved engineering design analyses, since Monte Carlo methods are used as standards for correcting more approximate methods. The relatively small number of vectorized programs is a consequence of the newness of vectorized Monte Carlo, the difficulties of nonportability, and the very large development effort required to rewrite or restructure Monte Carlo codes for vectorization. Based on the successful efforts to date, it may be concluded that Monte Carlo vectorization will spread to increasing numbers of codes and applications. The possibility of multitasking provides even further motivation for vectorizing Monte Carlo, since the step from vector to multitasked vector is relatively straightforward.

9903 Information Handling

REFER ALSO TO CITATION(S) 46366, 46367, 47366, 47987

48014 **(INDC(CCP)—283) BROND: USSR recommended evaluated neutron data library.** Manokhin, V.N. (USSR State Committee on the Utilization of Atomic Energy, Obninsk (USSR). Nuclear Data Centre) (ed.). (International Atomic Energy Agency, Vienna (Austria). International Nuclear Data Committee). Mar 1988. 184p. NTIS (US Sales Only), PC A09/MF A01. Order Number DE88703864/JAW.

Translated from Russian.

BROND is the recommended evaluated data library of the USSR for neutron induced nuclear reactions. It is a computer library recorded on magnetic tape presented in the internationally recommended format ENDF-5. It contains 65 files with recommended data for 65 elements or isotopes. For each file the present report gives a summary documentation on the contents, the evaluation methods and the originators of the files. (author). Refs.

48015 **(IYF-R—5-303) On the form of optimal information networks with linear quasi-order relations.** Gasanov, Eh.Eh. (AN Uzbekskoj SSR, Tashkent. Inst. Yadernoj Fiziki). 1987. 13p. (In Russian). NTIS (US Sales Only), PC A03/MF A01. Order Number DE88703641/JAW.

Mathematical model of information searching, which is represented as searching of all elements, having the fixed relation (a searching relation) to some element (a request), in the finite set of elements (a library) is suggested. Scheme of searching is reflected by means of special structures - information networks. The shape of optimal information networks and exact evaluation of it's complexity in case, when the searching relation is linear quasi-ordering relation, are obtained. 2 refs.

48016 **(LA—11341) Computerized classified document accountability.** Norris, C.B.; Lewin, R. (ed.). (Los Alamos National Lab., NM (USA)). Aug 1988. Contract W-7405-ENG-36. 19p. NTIS, PC A03/MF A01; 1; GPO Dep. Order Number DE88015054/JAW.

This step-by-step procedure was established as a guideline to be used with the Savvy PC Database Program for the accountability of classified documents. Its purpose is to eventually phase out the use of logbooks for classified document tracking. The program runs on an IBM PC or compatible computer using a Bernoulli Box, a Hewlett Packard 71B Bar Code Reader, an IOMEGA Host Adapter Board for creating mirror images of data for backup purposes, and the Disk Operating System (DOS). The DOS batch files "IN" and "OUT" invoke the Savvy Databases for either entering incoming or outgoing documents. The main files are DESTRUCTION, INLOG, OUTLOG, and NAME-NUMBER. The fields in the files are Adding/Changing, Routing, Destroying, Search-Print by document identification, Search/Print Audit by bar code number, Print Holdings of a person, and Print Inventory of an office.

9904 Law

48017 **(IAEA-INFCIRC—20(Add.2)) Texts of the Agency's relationship agreements with specialized agencies.** (International Atomic Energy Agency, Vienna (Austria)). Mar 1988. 10p. NTIS (US Sales Only), PC A02/MF A01. Order Number DE88703819/JAW.

Hard copies are available in English and French from IAEA Division of Publications, Distribution Unit.

The text of the relationship agreement which the Agency has concluded with the United Nations Industrial Development Organization, together with the protocol regarding its entry into force is reproduced. The agreement entered into force on 9 October 1987.

48018 **(IAEA-INFCIRC—167(Add.13/Mod.1)) Text of the regional co-operative agreement for research, development and training related to nuclear science and technology, 1987.** (International Atomic Energy Agency, Vienna (Austria)). Mar 1988. 1p. NTIS (US Sales Only), PC A02/MF A01. Order Number DE88703820/JAW.

The document contains the correct cover page of the document INFCIRC/167/Add.13 and an update of the information concerning notifications of acceptance.

48019 **(IAEA-INFCIRC—351) Communications received from Argentina and Brazil.** (International Atomic Energy Agency, Vienna (Austria)). May 1988. 8p. NTIS (US Sales Only), PC A02/MF A01. Order Number DE88703823/JAW.

Hard copies are available in English, Portuguese and Spanish from IAEA Division of Publications, Distribution Unit.

The document reproduces the Joint Declaration on Nuclear Policy signed by the Presidents of Argentina and Brazil on 30 November 1985, the Protocol on Nuclear Co-operation between Argentina and Brazil signed on 10 December 1986, the Joint Declaration on Nuclear Policy signed by the two Presidents on 10 December 1986, the Joint Declaration on Nuclear Policy signed by the two Presidents on 17 July 1987 and the Joint Declaration on Nucle-

ar Policy (IPERO Declaration) signed by the two Presidents on 8 April 1988.

9905 Civilian Defense

48020 **(ORNL—6355) Expedient antibiotics production: Final report.** Bienkowski, P.R.; Byers, C.H.; Lee, D.D. (Oak Ridge National Lab., TN (USA)). May 1988. Contract AC05-84OR21400. 197p. NTIS, PC A09/MF A01; 1; GPO Dep. Order Number DE88013328/JAW.

The literature on the manufacture, separation and purification, and clinical uses of antibiotics was reviewed, and a bibliography of the pertinent material was completed. Five antimicrobial drugs, penicillin V and G, (and amoxicillin with clavulanic acid), Cephalexin (a cephalosporin), tetracycline and oxytetracycline, Bacitracin (topical), and sulfonamide (chemically produced) were identified for emergency production. Plants that manufacture antibiotics in the continental United States, Mexico, and Puerto Rico have been identified along with potential alternate sites such as those where SCP, enzyme, and fermentation ethanol are produced. Detailed process flow sheets and process descriptions have been derived from the literature and documented. This investigation revealed that a typical antibiotic-manufacturing facility is composed of two main sections: (1) a highly specialized, but generic, fermentation unit and (2) a multistep, complex separation and purification unit which is specific to a particular antibiotic product. The fermentation section requires specialized equipment for operation in a sterile environment which is not usually available in other industries. The emergency production of antibiotics under austere conditions will be feasible only if a substantial reduction in the complexity and degree of separation and purity normally required can be realized. Detailed instructions were developed to assist state and federal officials who would be directing the resumption of antibiotic production after a nuclear attack. 182 refs., 54 figs., 26 tabs.

48021 **(ORNL/TM—10423) Technical options for protecting civilians from toxic vapors and gases.** Chester, C.V. (Oak Ridge National Lab., TN (USA)). May 1988. Contract AC05-84OR21400. 38p. NTIS, PC A03/MF A01; 1; GPO Dep. Order Number DE88013089/JAW.

Costs and quantitative estimates of effectiveness of general technical options for protecting civilians in place against very toxic vapors are provided and compared with possible hazards. Useful protection can be obtained by taking refuge in enclosed spaces if the leak rate is low, cloud passage is quick and it is possible to tell when the cloud has passed. A variety of charcoal filters and masks are available in the US and abroad which give good protection at reasonable prices if there is some system to warn the people to use the protective equipment. The most cost-effective method of protection found is a mouthpiece respirator which costs less than $14.00 and can be donned in seconds. Protection for a single room in a residence by a charcoal filter and blower can be obtained for under $1000. In cool weather, the population of a mass shelter can be provided with a charcoal-filtered air supply (of 3 cfm per person) for about $10/person. 14 refs., 6 figs., 4 tabs.